The Gold Inlay.*

By J. V. Conzett, D.D.S.

The science of operative dentistry, like all other sciences, is still in a state of evolution, and while great advances have been made in the past fifty years, we have not yet found the ideal filling material. We move in circles, advancing and going back, progressing and retrogressing, so that very frequently the method or material that is lauded to the skies to-day is discarded to-morrow. Yet, with all of the disappointments that have come to us in the past through the failure of methods or materials upon which we have hung our hopes, we have still advanced, rising upon the stepping-stones of our failures and ever looking for the perfect material and the perfect method of restoring lost dental tissue.

The gold filling in the past has been the greatest tooth-saver at our command, and to-day it stands without a peer in its special field when perfectly adapted to the walls of the cavity in a tooth. We must admit, however, that gold is a difficult material to manipulate, and the strain upon the patient is often a contra-indication to its use. Hence the profession has hailed with delight a method of using the good qualities of gold in a manner that lends itself to the ability of the average operator, and which at the same time is very much easier on the patient.

In the enthusiasm engendered by the gold inlay, for this is the method to which I have reference, there has been a failure properly to appreciate the necessity for a careful and scientific cavity preparation. Inlays have been, and are now being, made in cavities entirely devoid of any semblance of scientific preparation, and the result is sure to be a tremendous crop of failures in the not very distant future. For while it is true that a poor inlay is better than a poor gold filling, and it is true that the cement will save the tooth for a greater or lesser space of time, whether the inlay fits perfectly or not, too much dependence must not be placed upon a material that is as confessedly unreliable as the cements that we are now compelled to use.

The ideas of the profession in relation to the cavity preparation for the gold inlay are decidedly chaotic, and there seems to be no definite system of cavity preparation that is followed by any large number of men. It is because of that fact that the writer has been induced to present his methods, in the hope that what has been of so much benefit to him may help someone else.

In the series of articles which have recently been published by the writer upon the filling of teeth with gold, certain fundamental principles of cavity preparation were laid down that will bear repeating here, inasmuch as the same principles are as applicable to the filling of a tooth with an inlay, as to the filling of the same with any other material. For it makes no difference what material we may use to fill the cavity, there are certain principles that we must observe if we are to have permanent results. In our pursuit of the new let us not forget the good things of the old, and let us always remember the exhortation of the Apostle to "prove all things, to hold fast to that which is good."

The fundamental and most important principle in the filling of teeth, or indeed the making of any operation, is a careful study of conditions. There is a one best way, and a one best material with which to fill every tooth, and the conscientious dentist will want to use that way and that material which his experience and knowledge indicate as the best for the case in hand. In order to have the knowledge that will enable him to decide which material or method is the best for any case, he must make himself the master of all materials and all methods. I do not think that a man rightly deserves the name of "operative dentist" who has not so equipped himself. Each case that presents itself should be carefully studied in all of its various aspects, and after such a study the material and the method should be selected that will best conserve the interests of the patient.

Fundamental Principles of Cavity Formation.

There are four principles that should always be observed in our cavity preparation, whatever may be the material that we are to use in filling the cavity: First.—The outline form. Second.—The resistance form. Third.—The retentive form. Fourth.—The convenience form. The outline form comprehends the extension for prevention and the esthetic form.

Extension is as important in the inlay method as it is in any other method of filling teeth. Happily it is not necessary to advance any arguments in support of that theory now, as the doctrine is accepted by all advanced thinkers in the realm of operative dentistry, and to criticise it is to admit the fact that the critic is not aware of the position taken by the leading men in the profession. But, while all admit the necessity for extension, there is still a great difference of opinion as to the extent of the cutting that is necessary to perfectly protect the tooth from further progress of decay.

Susceptible and Immune Areas.

The lines of the finished filling must all be laid in the territory of relative immunity to decay. We know that there are certain portions of the tooth that are especially suceptible to the beginnings of caries, and other surfaces that are practically immune. The doctrine of extension for prevention contemplates the placing of the margins of all cavities, whether the decay is great or small, in the territory of immunity. This territory is any surface of the tooth that is habitually kept clean by the excursions of the food in mastication, the movements of the cheek and lips, and the use of the tooth-brush. These surfaces are the smooth surfaces of all of the teeth that are free from the proximating teeth, and sufficiently far from the gingival margin to prevent the débris of food from collecting. The susceptible surfaces are those surfaces that have organic defects, as the pits and grooves that are not perfectly closed by the fusion of the enamel plates, and all of the smooth surfaces that are not kept clean, as the proximal portions of all of the teeth and the gingival thirds of the same.

The proximating portions of the teeth are not kept habitually clean because the food, in its excursions over the teeth in mastication, is prevented from going in between the teeth by the contact point, and as a consequence the organisms of decay can fasten themselves to these surfaces, and then protecting themselves with the gelatinous plaque of Williams, are able to carry on their work of destruction with perfect impunity.

The gingival third is not habitually clean by reason of the fact that the gingivo-occlusal aspect of the tooth presents a curve that leaves

the gingival third in a position that the food misses in its passage over the surfaces of the teeth during the progress of mastication. This can be readily demonstrated to the satisfaction of any observer if he will take any tooth and pass a straight piece of wood or any material over the surface of the tooth and see that as it passes from the occlusal to the gingival surface there is a portion of the tooth answering to the gingival third that it entirely missed in the passage of the material from occlusal to gingival.

The imperfect pits and grooves are susceptible by reason of their imperfection; if they were perfectly closed they would be immune, as they, for the most part, lie in territory that is habitually kept clean, so that in the preparation of these cavities it is only necessary to so extend the cavity that all imperfections of the pits and grooves shall be obliterated and the margin of the filling be placed in smooth territory.

Extension then, as we have seen, contemplates the placing of all the margins of all cavities in immune areas, which, we have also seen, are the surfaces of the teeth that are habitually kept clean by the excursion of the food during mastication. This matter will be taken up at greater length at the time when we study the preparing of cavities by classes.

The Esthetic Form.

The esthetic form is the form that is given to the finished filling that will in the greatest measure conserve the beauty of the tooth and the individual. Wherever gold is plainly visible it is at best an unsightly material, but its great preservative attributes causes us to use it at frequent intervals even in those places that are within the range of vision; but when we do so it is our duty to make the filling as beautiful as possible. This can be done by observing certain artistic principles that are matters of common knowledge, but are, nevertheless, frequently violated in the making of fillings. First, the lines of the filling that are brought into view should all be curves and never angular, as a curve is always more artistic than an angle. Second, the gold should be hidden as much as the exigencies of the case will allow. This does not mean, however, that extension for prevention should ever be neglected, but an unwarranted display of gold should never be made. While this is true, it is also true that when the filling comes nearly into view it is better to bring it into full view, as the line that is seen when a gold filling is nearly to the surface, but not quite, looks like a black line and is a positive disfigurement. The rule, then, is to cut the cavity far enough to bring the filling into full view, thereby showing the true character of the filling and not making it look like a decay between the teeth.

The Resistance Form.

The resistance form is that form given to the cavity that will serve to prevent the forces of occlusion from driving the filling out of the cavity, or so changing the shape of the filling that it will cease to save the tooth. In mechanics it is axiomatic that a flat base is the most secure foundation, and the same principle holds good in dentistry. We can best resist the forces that are brought to play upon the finished filling if we place that filling upon a foundation that is flat. The rule, then, is to make all seats flat, whether the seat is a gingival, occlusal or axial; all should be as flat as it is possible to make them. This will be illustrated when we examine the cavities that we will prepare in the various surfaces of the teeth.

The Retentive Form.

The retentive form is that form that is given to the cavity that will resist the forces that have a tendency to dislodge the filling from the cavity, and is partly arranged for in the resistance form. More than the mere resistance form is necessary, however, for the resistance form only contemplates the resistance of the forces that are of a driving nature, and it is obvious that there must also be provision against the tendency to pull the filling out of the cavity. This, in the past, was accomplished by the making of pits and grooves in the sides and bottom of the cavity. This, for obvious reasons, would not be permissible in a cavity that was being made for the reception of an inlay, for in that case the interior of the cavity would be larger than the exterior, and it would be impossible to withdraw the model. It is just as improper a preparation for a filling, for we have found that grooves and pits weaken the tooth without giving sufficient security to the filling. As we progress in our cavity preparation, we will find (to the surprise of many, I doubt not) that the preparation of a cavity for an inlay does not materially differ from the preparation that we give the tooth for the reception of a gold filling. When the master workman, Dr. G. V. Black, gave us his system of cavity preparation, he gave us the fundamental principles that are applicable for all materials that we will ever want to place into a tooth for its preservation.

We have, then, the flat seats that we expect to resist the pounding forces of mastication, and we will add to these those lines that we will expect to so finish our preparation that it will also resist the pulling forces that will tend to dislodge the filling from the cavity, and the best form that we can give the cavity is the form of a box. The more nearly we can approach this in all of our cavity preparation the more nearly will we approach the ideal, as we will see in our cavity preparation by classes.

The Convenience Form.

The convenience form is that form that is given to a cavity that will make possible the perfect placing of the filling material. This form is a positive necessity in the making of a gold filling and to a greater or less degree is also necessary in the making of an inlay. This form is not arbitrary; it may take one shape for one operator and quite another for another. In this the personal equation of the operator plays a very great part. One operator may with ease fill a cavity of one shape that would be quite impossible for another operator. The rule is to so shape the cavity as to its convenience form, that the operator may be able to perfectly place his finished filling, for, no matter how good may be the cavity preparation, if the operator is not able to perfectly adapt his filling material to the walls of the cavity, his filling will fail.

Margins.

The last point to observe in the preparation of the cavity, but the one that is of the utmost importance, is the finishing of the cavo-surface margin. The cavo-surface angle is the outer surface of the cavity, and is placed in the enamel, except in the case of a cavity being carried so far gingivally that the margin is laid in the cementum. This margin should always be beveled, so that the enamel rods may be protected and not fall out after the filling has been finished and cause a leak that will endanger the life of the filling. In order to fully understand the best way to perfectly obtain this bevel in all parts of the cavity, one must understand the histological structure of the enamel, and while we shall attempt to take the matter up in a practical manner in this series of papers, the practitioner is advised to carefully study the magnificent work on this subject by Dr. Fred. B. Noyes in the "American Text-Book of Operative Dentistry."

The Dental Hygiene Conference and Exhibit in New York City.

By Beatrice C. Fairchild, D.D.S.

An event has recently taken place under the auspices of the Dental Hygiene Council of the City of New York which will mark an epoch in the history of dentistry. That event was the holding, with the co-operation of the Children's Aid Society, the Association for Improving the Condition of the Poor, and the Charity Organization Society, of a Dental Hygiene Conference and Exhibit in the Assembly Room of the Metropolitan Life Insurance Building, during the week beginning Thursday, May 12, and ending Wednesday, May 18, 1910.

This public movement for the preservation of the teeth, and especially children's teeth, is a purely educational campaign. Never before has there been held anywhere an exhibit of such size in the interests of mouth hygiene. Public attention has never been called so forcibly and impressively to the lamentable fact that "seventy per cent. of all children enter school as physical incompetents," and as Dr. George W. Coler (one of the speakers) said: "This statement applies not only to the children of the lower classes, but the children of all, not because they are born weaklings, but because their parents were not trained to care for their children."

Dr. Luther H. Gulick (formerly physical director of the New York public schools and now head of the department of child hygiene in the Sage Foundation), said investigation had proved that at least one-half of the school children have seriously defective teeth, and that it takes those children six months longer to complete the eight grades of the elementary course than it does the ones with good teeth. Dr. Gulick said it cost New York infinitely more for educating children having decayed teeth than it would if their teeth were in good condition.

During the entire week of the conference popular lectures were delivered in both the afternoon and evening by prominent speakers. On the opening night Professor Irving Fisher (Chairman of the Committee of One Hundred on National Health), Senator Robert L. Owen, of Oklahoma (father of the Federal Health Bill), Mr. William Church Osborn (President of the Children's Aid Society), and Dr. Woods Hutchinson, were the speakers.

Lectures.

Dr. Hutchinson waxed epigrammatic and said: "A man is known by the teeth he keeps. Spiritualized and cultured as we have become, we still fight the battle of life with our teeth, although we no longer chew our enemies' ears and throats. The psalmist who said, 'Keep thy mouth with diligence,' was a good dentist and a sound philosopher. If he had added, 'and with a tooth-brush,' he would have been strictly up-to-date. Our teeth still make our expressions, give to our faces the air of firmness or weakness, determination or irresolution; make their shape oval, triangular, or square; gives us the wolfish, rabbit-like, horse-like or the bulldog expression.

"When we frown we inevitably clench our teeth and set our jaws, as if we were locking them into the body of the enemy. When we sneer we wrinkle up one side of our upper lip to bare the big ivory dagger, our canine tooth, or, rather, the place where we used to carry it. Look at our teeth with the biologist's eye and you will see that they contain samples of every known kind of teeth possessed by any animal—incisors,

canines, bicuspids and molars; flesh-eating, grain-eating, nut-eating, fruit-eating, carnivorous and herbivorous.

"The mouth makes a beautiful hothouse for 'bugs' of all sorts, but they must have something dead to live on. If the gums and the teeth are kept thoroughly alive and vigorous, they can get little foothold, but if some carrion in the shape of scraps of food be left them to form a nest in, then they develop a vigor which will enable them to attack the teeth and the gums.

"Give children plenty of toughening food to chew, and their teeth will get the pearly vigor of the savage's tooth. Above all, the food should be of such a kind as to give exercise to the gums. Brush the gums well. Take plenty of coarse food."

On Thursday afternoon Dr. Thaddeus P. Hyatt, of Brooklyn, spoke to over seven hundred school children and sent every child home that night with an educational message for his parents.

On Friday afternoon Dr. Frederick L. Stanton spoke to an audience of pupils from the Children's Aid Society schools. In the evening the speakers were Drs. George W. Coler, Luther H. Gulick, C. Ward Crampton, and Mr. R. S. Wallace. In Dr. Coler's address he said, "Bad teeth cause bad stomachs. The body becomes filled with bacteria, followed by scores of diseases and infections. Most of the deformities are produced by tooth decay, resulting in hunch-backs, club-feet, knock-knees, small-pox, and even scrofulous conditions, with stunted bodies and irregular faces in our children."

On Saturday evening Dr. Thaddeus P. Hyatt was the speaker.

On Sunday afternoon the exhibition was open between one and six o'clock.

Monday evening was Mothers' Night. The speakers were Drs. S. Adolphus Knoff, Sarah Josephine Baker, William R. Woodbury, and Miss Katherine Blake.

On Monday afternoon Dr. W. D. Tracy addressed an audience of over seventeen hundred public school children. By the prompt and intelligent responses which Dr. Tracy received to his questions, it was found that the child could be made to take an interest in the care and value of his teeth. Each child on this occasion was sent home with the following sentence fixed firmly in his mind. "A clean tooth never decays." The following extract from a composition written by a child of twelve, after her visit to the conference, will show the thought which the above sentence caused. So good is her suggestion that it might be well to put it into effect:

"Next we saw the tooth-brush, the sole guardian of the teeth, and the motto, 'A clean tooth never decays,' shown to us four times, so as to

impress it upon our minds. What a good idea it would be to have that motto on the back of every tooth-brush!"

The lecture on Thursday evening was for the Social Workers. The speakers were Drs. William R. Woodbury, of Boston, J. J. Cronin, and Miss M. L. Linly.

The closing night Dr. A. H. Stevenson was the speaker.

Exhibits.

Besides the lectures there was exhibited in a large room adjoining the Assembly Hall plaster casts showing conditions as they are found to exist. Also placards and charts showing the result of neglect and ignorance. There were several large screens covered with burlap, on which were hung striking illustrations and printed texts planned to drive home wholesome truth to the minds of those who were neglecting their mouth and teeth. "A tooth-brush in time saves nine," was the style of text used.

Another striking illustration setting forth the value of early education in mouth hygiene was shown by the comparison of two sets of plaster models. In a large frame eighteen by twenty-seven inches, and mounted against a black velvet background, were placed two sets of plaster casts. One was the model of the mouth of a girl seventeen years old. There were but two remaining teeth, though the decaying roots of the lost teeth were visible in each jaw. Above this was printed, "A Neglected Mouth." Beside it were casts representing the upper and lower teeth of a girl twelve years old. But every tooth was in its proper place and condition. Above this was printed, "A Well Cared for Mouth."

Among the models were seven which had been painted in oil to represent certain conditions as they existed in the mouths of children between the ages of seven and twenty-one. These cases were found in tht dental clinics of the Children's Aid Society on Fifty-third Street.

Literature Distributed.

To further interest the public, fifteen thousand little booklets setting forth ten good reasons for a clean mouth were distributed during the week. The following are the ten good reasons:

1. Good health.
2. Good digestion.
3. Good breathing.
4. Good looks.
5. Prevents swollen faces.
6. Prevents trouble with eyes, ears, nose and throat.
7. Prevents infectious diseases.
8. Prevents tuberculosis.
9. Prevents nervous diseases.
10. Saves money.

There were fifty thousand cards distributed inviting the school children to attend the lectures. The following was printed on the back of each card:

Your Health is no better than Your Teeth
Your Looks are no better than Your Teeth
Your Comfort is no greater than Your Teeth
Your Success is no greater than Your Teeth
Come and Learn to care for Your Teeth

It is impossible to measure the influence by the week in New York, but it is gratifying to know that the Chairman of the Exhibit Committee is receiving letters from all over the country making application for the loan of the material used in the exhibition. And it is gratifying to know that of all the letters received only one was from a dental organization. This will demonstrate that it is possible to interest the public in such an educational reform.

The exhibition in New York was unlike any other ever held. All the talks were of a popular nature, and, except for the stereopticon lectures for children, were not given by dentists.

The attendance during the week was between nine and ten thousand people.

A great reform has begun here, a reform that will help to educate parents to their responsibilities in matters of mouth hygiene.

That the Dental Hygiene Conference and Exhibit was the splendid success it was, is due to the untiring efforts of the Conference and Exhibit Committee, which was composed of very busy men who gave gratuitously and unceasingly of their time and influence. The members of this committee were: Arthur H. Merritt, D.D.S., Chairman; Thaddeus P. Hyatt, D.D.S.; Frederic C. Kemple, D.D.S.; Henry V. Andrews; Frederick D. Green; Robert Bachman, Jr.; W. Frank Persons; Mathew P. Adams, Secretary.

Quoting from one of the briefs: "The care of the teeth is just as important as the care of forests; in both cases we are dealing with the conservation of natural resources. Care and intelligent attention to the teeth, especially during childhood, will save health and money, prevent pain and disease, and promote efficiency and physical comfort. There are few questions more important than those of preserving the children's teeth."

The Operating-Room.

By C. W. F. KABELL, D.D.S., Chicago, Ill.

Smilingly one recollects the equipment of the operating-rooms of forty years ago with its foot engine, home-made instruments, its clumsy chair, resembling grandpa's easy-chair; over it, as signs of housewifely care, the tidies and, perhaps, a slumber roll with the embroidered device: "Only fifteen minutes," a very appropriate little motto, at a time when the dentist was mostly visited for the hated extractions.

The other furniture was of the pattern of the everywhere found, solid, plain household article, as the waiting-room would serve on Sundays and holidays as the parlor for company.

Those times are gone. We now have especially designed furniture of unmistakable dental design. Electricity has superseded pedal labor, and our operating-chairs with their levers, iron castings and bright nickel are beauties of constructive ingenuity.

Everything is practical. Red is the predominating color of the plush, not fading so easily. The motors with their glistening array of nickel-plate and shining steel or appropriately oxidized, proudly dangle from the ceiling or adorn the walls. The many drawered dental cabinets tell of a wealth of instruments; sterilizers assure the effective prevention of horrid infection, and, in short, everything shows the high development of dentistry, and we are justly proud of it.

But, how about the patient? Does it tend to reduce his nervous fear of the dental operation, to be ushered into a room which first looks to him like a machine-shop? Or, does it relieve him to think that the multiple drawers are full of instruments, mostly of torture, which will be successfully tried on him?

Would you blame him when he hesitates to sit down in a chair that looks to him to be full of secret devices to clamp him down and prevent him from kicking?

The red of the chair seems to him practical because it does not show the blood spots; sterilizers teach him that filling a tooth is not quite harmless as he expected, and many more often very foolish illusions spook in the minds of the laity.

I have probably exaggerated a little, but in the main, I will wager that most of my fellow-dentists have listened to some of the above-named objections from their patients.

Effects of Mental Suggestion.

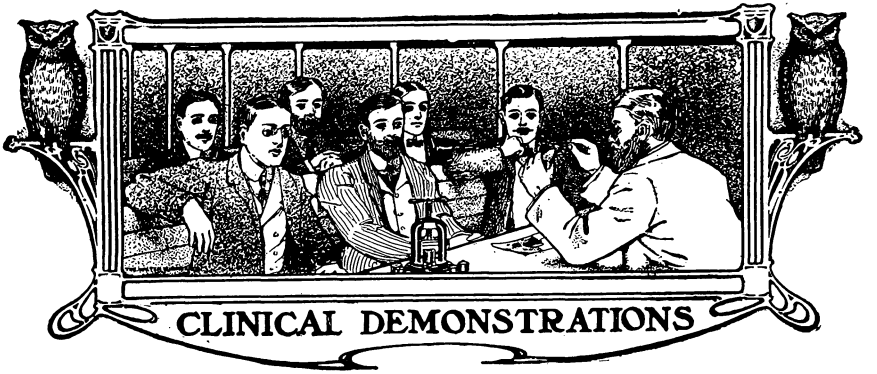
In the light of the researches of psychology, we must now consider that this criticism might not consciously come to the layman, but that the subconscious mind, by the above-named or similar associations, sets up a definite consciously felt fear in the patient, which subdues his reasoning powers and makes the operation very trying to the dentist.

I have to ask now the question whether it is really necessary openly to exhibit everything we need in our profession, imitating often the operating-room of a hospital? Just think of the pressed steel dental cabinets, antiseptically white and ultra-modern! Can we not try to hide everything that awakens the suspicion and fear of our patients and by pleasant chats in a home-like arranged operating-room endeavor to make the patient forget the pain we must inflict?

My ideal of an operating-room is as follows: Blue should be the predominating color. The soothing effect of blue on the nervous system has been experimentally established. Operating-chairs, lounge and easy-chairs to have identical tapestry or silk covers; fountain spittoon with blue glass inner bowl. Engine and motor to be hidden by a cabinet arrangement of especial designs, dental cabinet of fancy carved fashionable parlor design, with a limit of drawers. Linoleum of conventional pattern, with a rug covering part of it; good pictures in gold frames covering the walls; fresh flowers in a vase, to catch the eye; in fact, disguising the purpose as much as possible.

A suggestion to the chair manufacturers would also be in place; to reconstruct their chairs so that they lose some of their cruel outline; in fact, every manufacturer should tax his ingenuity in remodeling his dental specialties, because I can not see why our surroundings should not have the highest artistic and most beautiful forms in conjunction with their practical usefulness.

Dentistry will never become a pleasure, but I consider it our foremost duty to try to relieve everyone of as much anxiety as possible, and I believe my suggestion leads in the right direction, and it certainly will elevate the profession when the dentist will not merely be a machine operator but the operating-room will be the mirror of his individuality and culture.



Replacing Fractured Facings.

By GEORGE H. KOEGLER, D.D.S., New York.

The following is, I think, the easiest way to replace exactly a fractured facing on a bridge, whether it be porcelain or gold. Let us take a bridge consisting of a canine Richmond for the anterior abutment, then two bicuspids dummies, and a gold crown for the posterior abutment.

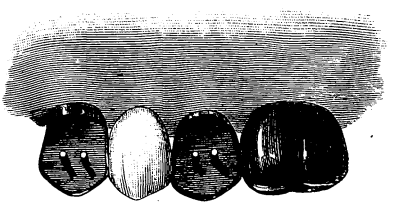


FIG. 1.

Suppose facings have been broken from the Richmond and second bicuspids (Fig. 1). Clean backing thoroughly of all porcelain. If there are any rough places on backing, leave them there. Now dry backing and cover pins with cement and allow same to harden. Then take a stone and grind cement flush with end of pins and cut down sides as much as possible without exposing pins; be sure to keep sides parallel. We now have a cement box covering our pins, and our Richmond appears as in Figure 2.

Take a piece of platinum foil and burnish to backing and over portion covering root. Remove, invest and bake facing the shade you want. Now remove cement from pins and try facing on backing. Dry backing and facing, mix some good inlay cement and cement facing to backing, and you will have a perfect repair in every detail.

When facings have been broken off posteriorly to first bicuspid, I replace same with gold. The preparation for a gold facing is the same as for the porcelain. Soften a piece of inlay wax and hold it against backing until it is hard, then carve to suit. Place sprue-wire in same, remove and cast, and proceed with finishing of it as you did with the porcelain. Where the facing rests against gum, as the second bicuspid in Fig. 1, I always take an impression and make model of same in copper

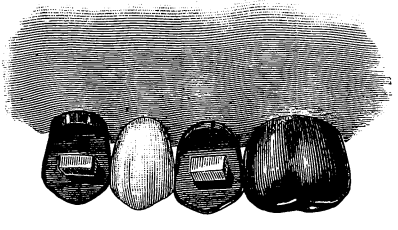


FIG. 2.

amalgam, as I can then carve gum on model, and when I put facing on bridge it fits the gum snugly. I have used the above method for about two years and find the facings hold.

A Simple Method of Replacing a Facing.

By James B. Hodgkin, D.D.S., Manassas, Va.

A simple and effective method of replacing a broken facing lost from a broken Richmond crown, and in some cases a facing broken from a bridge, is here described. I have used this method for some years, and in suitable cases it seems more efficient than any of the many methods in vogue.

After selecting a suitable facing to replace the fractured one, and grinding it to position, cut out a piece of platinum foil suitable for

a backing. It may be made of gold, if preferred, but I have used platinum on account of infusibility. It should be thin, so as to be easily shaped and burnished to fit, and also that it may occupy as little space as possible. Now shape the carbon of an ordinary pencil into a "former," slightly conical. This should pass between the pins of the facing, fitting somewhat closely (Fig. 1 A), and should be somewhat tapering, like an ordinary cut nail, the thick end towards the upper end of the facing. File the ends of the facing-pins nearly level with the carbon, the previously mentioned backing being in place on the facing. Remove the carbon "former" and cut another piece of thin platinum as before, the size of this to be governed by circumstances. This second piece is to be burnished down on top of the first backing, and at right angles to it. It should be sufficiently long to overlap when bent over, as now to be described. If preferred, the second piece of platinum may be bent about the carbon "former," and placed *inside* the pins instead of outside, as this would ensure that the

a *b* *c*

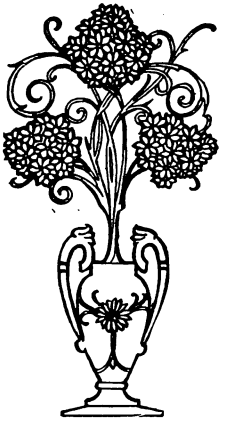
FIG. 1.

solder would flow and make a smooth, uniform hole. With both backings in position, place the carbon "former" between the pins and on top of second backing, remembering to place the small point of the carbon towards the cutting edge of the facing. Bend the ends of the second piece of platinum over the carbon, burnishing down as closely as is needful. Fig. 1 B shows second backing bent over former, but not yet brought down. It will not touch the carbon at the region of the pins, but that does not matter. Wax all over carefully, trying to get the wax in the vacant space where the platinum does not quite touch the pins. Invest and flow fine solder over all: when cool, remove investment, carbon, etc., and there will be a tapering hole through the soldered backing. The size of this hole is, of course, regulated by the size of the carbon, the guide to the size being regulated by observation of the thickness of the backing of the broken crown.

The work, after soldering, is to be finished to good shape, and attention is now devoted to the broken tooth, or rather to the remaining backing, which is to be formed with suitable instruments to the shape of the hole left in the tooth by the carbon. This being done, the tooth is tried on, the fit completed and the tooth cemented to place.

In cases where the bite is close, and there is no room for the additional thickness made by the extra backing of the tooth. a modification of the method may be made by shaping the carbon "former" as seen (end view) in Fig. 1 C. The work is done in this case by placing the carbon, thus shaped, with the broad side next the platinum facing, and proceeding as before; but when the soldering is completed, file or grind the backing away until the hole is exposed, leaving a simple dovetailed space. The backing on the broken tooth is to be shaped to fit this space, and thus the space which the backing would have occupied is gained for occlusion.

The method here detailed may be used in some cases for repairing bridgework. The technique is obvious.



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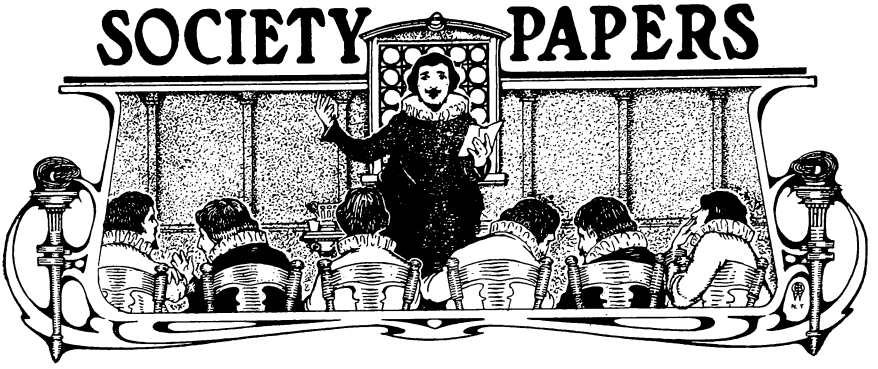


Casting to Models, Its Advantages and Technique.

By Weston A. Price, D.D.S., Cleveland, O.

Read before the Second District Society, Brooklyn, N. Y., January 11, 1910.

To judge high standards for both the completed operations and the methods for producing them, we must have clearly in mind both the ideals to be attained and the fixed conditions to which all else must be adapted. For the former, we instinctively use as a high standard the splendid malleted contour gold fillings that have preserved the teeth and done splendid service for decades. Their grand success is due to their excellent margins and contours and compatibility.

Let us take for our standard for judging and constructing inlays, contours that are even more perfectly adapted than those, which, because of their inaccessible positions, were not usually near perfection, and margins that are even stronger and as closely and smoothly adapted to the tooth, and without a visible cement line at any point and without the possibility of the tooth underneath being checked from its insertion. Few of those splendid malleted fillings have perfect contact points, or produce anatomical interproximal spaces; so we can easily appreciate a higher standard for these.

The Ideal Filling.

Owing to the necessity for having a certain mass of gold to have strength with a malleted gold, that kind of filling requires excessive cutting of the tooth structure, frequently at both the step and the angle for extension for prevention. Our ideal will naturally desire more strength with less loss of tooth structure. The surface of an ideal filling

must be hard and smooth, but the structure must not be brittle. The margin must be tough and pliable, but not springy; compatible to the tooth structure and not producing thermal shock; and should, to prevent causing pulp stones and secondary deposit of dentine in the pulp chamber, be a non-conductor or be insulated from the dentine by an electrical non-conductor. It must be so rigidly attached as not to allow of its being dislodged by an excessive strain and preferably be so strong as to allow of anchoring one end of a bridge to it when desirable.

Next in importance to the efficiency of the completed filling is the comfort during its insertion, first, of the patient and, second, of the operator; for an operation is not only not a success, but a prodigious failure, which so persecutes the patient as to cause him or her to neglect many other equally important teeth, even though that operation remain in that tooth for a quarter or half a century. Operations claiming to fulfil high standards to-day must be made with so little real discomfort that they will not only be entirely acceptable to our physically strong patients, but entirely so for our physically and nervously weak patients, and without lowering our standards of efficiency for service. If, for example, those splendid large contour malleted fillings could be placed in position without taking an iota from the perfection of their margins or contours, by some method that would relieve the patient and operator of the discomfort and strain incident to malleting, grinding and polishing, we would certainly accept it as a higher standard. If also that filling were entirely homogeneous as is a fused metal, its surface would be much improved, especially if burnished till hardened, and if it be attached to the tooth without strain to the cavity wall, yet hermetically sealed, and also insulated electrically and, if possible, thermally, it will still fulfil a higher standard. The natural dread by our patients of the dental chair of the past is the direct cause of the loss of many times more teeth than ignorance on their part, and this is as important a fixed condition in dentistry for us to meet and correct as the dental lesions themselves.

Having these high standards in mind let us consider how nearly they can be attained by inlay methods and note especially the advantages and disadvantages of particular methods. As we do so, we must have in mind certain fixed physical conditions to which our methods and materials must be adapted. Chief of these are the physical properties of gold and its alloys which as yet have not been definitely and clearly presented. We must, to fulfil the above high standards, either have a means for controlling the contraction of gold, or in some way compensate for or correct that change, else we can not have perfect margins, and an inlay without as perfect margins as the splendid gold-malleted fillings may reach a

high standard from other viewpoints, but from that point is much short of ideal.

Conduct of Metals Used for Casting.

The writer has spent much effort for two years determining the fixed physical properties of gold and its alloys, and, while time will not permit of an extended review of them here, some facts or laws are essential for us to have in mind. The general fact that nearly all metals and alloys expand when heated and contract when cooled, is generally appreciated, but the laws governing that physical fact are not appreciated and few, if any, of the arts or sciences should be so concerned to-day to know them as the dental science.

The text-books or encyclopedias on physics mention little more than the fact that contraction occurs on cooling and the practical science of the arts and trades has developed it only for the base-metal, iron. The dental literature and teachings of the past couple of years have presented three essentially different, if not contradictory, phases of the subject. First, and the most general teaching, is to ignore entirely the contraction of gold on cooling, stated to be slightly, if any. The second is, that contraction normally exists, but can be controlled or prevented almost entirely by cooling the gold rapidly after casting. This is based by inference on the casting corrections or long rulers used by cast-iron workers, the pattern-makers for which use longer rules for larger pieces of cast-iron than for small ones: the latter of necessity cool much more rapidly, which reason is taken as the cause for less contraction. This rule is then applied to gold directly, assuming that it obeys the same laws as cast-iron, and the result is said to be accomplished by casting into a nearly cold investment.

Professor Ward, of Ann Arbor, is, I believe, the author and leader of this teaching and practice. The third teaching is that gold does contract on cooling from the melting-point a definite amount, under practically all conditions, and that amount over two per cent. or 1-50 of its dimension in all directions, but that the location of the shrinkage or contraction (not the total amount) can be partially transferred to another part of the cooling mass by pressure on the molten gold while it is in a semi-molten state, and that the distance or range in temperature below the melting or fluid point through which it can be moved from one part of the mass to another to take the place of contraction at that latter place is dependent upon the pressure used. This view was presented by the speaker, together with the reduction of contraction that certain definite pressures would give. The range of control is too short, owing to the conditions, to take care of all the contraction or even half of it. (See ITEMS OF INTEREST, May, 1908.) The behavior of gold as it changes its state, is being studied and will be presented later.

The expansion and contraction shown by + and — in thousandths of an inch of blocks of one-inch cube of the present investment compounds.

Temperature in Degrees F.	Peck's	Peck's ½ ½ Plaster	Imperial	Imperial ½ ½ Plaster	Fyrite	Fyrite ½ ½ Plaster	Dendrolite	Dendrolite ½ ½ Plaster	Sump	Sump ½ ½ Plaster	Dr. Taggart's	Dr. Taggart's ½ ½ Plaster	Pelton & Crane	Pelton & Crane ½ ½ Plaster	Plaster of Paris Medium	Plaster of Paris Thin	I. D. L. Investment Composition	I. D. L. ½ ½ Plaster	Plaster of Paris set 15 minutes then heated	Plaster of Paris set 15 hours
Started	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-min. setting and expansion	+.7	+.7	+.9	+.8	+1.	+.5	+.9	+.5	+.9	+1.	+.7	+1.	+1.8	+1.	+1.3	+1.	+.7	+.8	+.5	0
100	+.9	+.9	+1.2	+1.	+1.	+.8	+1.1	+.9	+1.4	+1.3	+1.3	+1.3	+1.8	+1.4	+1.4	+1.3	+1.1	+1.2	+.9	+.1
200	+3.1	+2.2	+2.2	+2.8	+2.4	+1.9	+2.3	+2.1	+2.9	+2.4	+2.3	+2.5	+2.5	+2.5	+2.6	+2.5	+2.	+2.8	+2.4	+.6
300	+3.7	+3.1	+3.1	+3.	+3.8	+3.3	+3.5	+3.6	+4.	+3.5	+5.1	+3.2	+3.2	+4.	+4.5	+3.	+3.2	+3.6	+2.6	+1.5
400	+4.5	+3.2	+4.	+3.4	+3.8	+3.4	+3.3	+3.6	+4.	+3.4	lost	+3.4	+4.	+4.	+4.5	+2.5	+3.8	+3.8	+2.5	+1.9
500	+5.1	+3.	+4.4	+3.4	+3.3	+3.2	+2.8	+3.5	+3.8	+3.	+6.2	+3.2	+4.8	+3.8	+4.3	+1.9	+4.1	+3.5	+2.2	+2.1
600	+5.7	+3.	+4.4	+3.3	+2.9	+2.8	+2.4	+3.4	+3.5	+2.5	+6.8	+2.9	+5.2	+3.7	+3.9	+1.	+4.6	+3.4	+1.5	+1.7
700	+6.4	+2.9	+4.5	+3.	+2.	+2.5	+1.5	+3.2	+2.8	+1.7	+7.3	+2.5	+5.7	+3.6	+3.4	—.1	+5.2	+3.	+.8	+1.
800	+6.9	+2.8	+4.6	+2.8	+1.4	+2.1	+.5	+3.	+2.1	+1.	+7.7	+2.3	+6.3	+3.6	+2.6	—2.	+5.5	+2.9	—.2	+.4
900	+7.2	+2.5	+4.8	+2.5	+.6	+1.3	—.5	+2.9	+1.2	0	+8.3	+.7	+6.7	+3.5	+1.4	—3.8	+6.	+2.5	—1.5	—.3
1000	+7.8	+2.	+5.	+1.8	—.5	+.3	—1.8	+3.5	+.2	—.9	+8.5	+1.4	+7.1	+3.3	0	—6.5	+6.6	+2.	—3.3	—1.
Total contraction on cooling	—7.	—11.	—10.	—12.	—12.	—15.	—35.	—14.	—15.	—14.	—6.	—11.	—5.	—11.	—18.	—24.	—8.	—15.	—18.	—15.

FIG. 1.

We are concerned only for scientific facts and will present the results of our further research only for that end. Dr. Lane, of Philadelphia, in a letter to the speaker, which was an advance synopsis of a paper he was to give before the Susquehanna Dental Society, stated that the only force that could be available to any advantage was simply the amount necessary to change the spheroidal tendency of the gold. Dr. Kabell, of Chicago, in the May, 1909, ITEMS OF INTEREST, in reviewing the recognized contraction, presented an experiment to show that the location of the contraction was not affected by air pressures on the sprue and investment differently between three and twenty-five pounds. Unfortunately, he introduces errors into his experiment which were larger than the unit he desired to measure, viz., the expansion of his instrument and depending on a semi-fluid mass of gold to pull on the head of a pin, for, after it is strong enough to pull the levers, it is too strong to be moved by twenty-

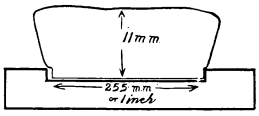


FIG. 2.

five pounds per sq. in. air pressure. It is exceedingly difficult to measure the exact contraction of a unit of gold without introducing errors that may be greater than the measurement we would record, for we will have the contraction or expansion of the wax form or model that we have measured, and the expansion or contraction of the investing material we have cast into. No investing material that the speaker knows of has constant dimensions when heated and cooled again within a wide range of error. The only acceptable substitute for it is fused quartz, which has less than one-fortieth as much expansion and contraction as gold for the same change of temperatures. In other words, when an inch column of gold on cooling in a fused quartz chamber contracts (without pressure to change the location of the contraction) over twenty-thousandths of an inch, the quartz chamber will contract less than one-two-thousandths of an inch. Investing compounds, in which these experiments are usually made, including all our commercial investments, vary from a maximum expansion at about 900 to 1000 degrees, of eight-thousandths for the best, to a contraction as much as fifteen- to twenty-thousandths, according to its manipulation. See table of expansions and contractions of investing materials at various temperatures (Fig. 1).

Fig. 2 shows a fused quartz block with a chamber or box one inch long, cut into one side and the actual contraction of the molten gold, in this case over an ounce. I have the original here and the dimensions were secured by projecting the shadow on to a screen and measuring, as well as by direct measurement. The pressure here is the weight of the column of molten pure gold eleven millimeters high, and since the weight of hydrostatic pressure of a column of pure gold 760 millimeters high is about fifteen pounds to the square inch, the pressure on the gold in the quartz box in this experiment is about one-third of a pound per square inch. This is certainly more than enough to control the spheroidal tendency, but has not prevented a contraction of over one-fiftieth of an inch, which would be a great deal in bridge abutment or large compound inlay. I have several quartz chambers into which pure gold was cast at various definite pressures, which show diminishing opening at the end of the bar, or, in other words, an increasing control of the location of the contraction. Those made with low pressures will rattle in their boxes, while those made at high pressures will not. The cylinder of cast-gold in a tube of fused quartz one-fourth inch high contains a casting made with no pressure except the weight of its column, and the gold will drop out.

Effect of Pressure at Various Temperatures.

To determine accurately the effect of definite pressures and the range of temperature at which they would affect or move the freezing or cooling gold, I made an instrument that heated a button of gold, or other metal, in contact with a thermo-electric couple. On the button was placed a quartz plunger about one-eighth inch square surface to correspond with even a very large sprue neck. On heating a two-pennyweight button fine gold it expanded normally about one-thousandth of its diameter for each hundred degrees F. under five-pennyweight load on the quartz, until it reached 1940 degrees F. and then kept sagging until it reached its melting-point at 1960 degrees F.; five pennyweights then could not modify or change the location of the contraction after the gold was cooled twenty degrees below its actual melting or fluid point. This would be about equivalent to one and one-fourth pounds air pressure per square inch on a sprue, or a little over. When the weight was increased to two ounces, equal to a little over ten pounds air pressure per square inch, the mass began moving at 1920 degrees.

Gold Alloyed with Aluminum.

At eight ounces, equivalent to a little over forty pounds air pressure per square inch, it began moving 1900 degrees, and at twenty-four ounces, equal to about 120 pounds air pressure per square inch on a sprue, it began moving at 1760. This will be the range of the cooling process through which pure gold will be moved and the location of its

TABLE OF BEHAVIOR OF GOLD AND ITS ALLOYS UNDER PRESSURE.

NAME OF METALS		24-kt. Gold	24-kt. Gold 99.9% Alum. 1/10 of 1%	Gold 99.8% Alum. 2/10 of 1%	Gold 99.5% Alum. 5/10 of 1%	Gold 99% Alum. 1%	Gold 95% Alum. 5%	Gold 90% Alum. 10%	Aluminum	Alum. 95% 20-kt. Gold 5% (20-kt. Gold = Au. 20 + Cu. 3 + Ag. 1 pts.)	Alum. 90% 20-kt. Gold 10%	22-kt. Gold Solder	20-kt. Gold Solder	18-kt Solder	Silver	Copper	Gold, 20 pts. Nickel, 4 pts.
WEIGHTS 5 dwts.	Sagging commences	1940 F.	1770 F.	1590 F.	1640 F.	1240 F.	1140 F.	1090 F.	1220 F.	1270 F.	1270 F.	1440 F.	1390 F.	1500 F.	1665 F.	1730 F.	1680 F.
	Weight drops	1960	1800	1870	1750	1490	1270	1140	1240	1292	1340	1610	1605	1520	1730	1915	Softens 2000
Sagging range to the drop under this weight		20	30	280	110	250	130	50	20	22	70	170	215	20	65	185	320
Sagging range to normal melting point		20	30	280	110	250	130	50	Normal melting point 1292 F. 72	22	70	170	215	20	Melting point 1870 205	Melting point 1996 266	Melting point unknown 320
1 oz.	Sagging commences	1940		1540	1540	1240	1110	1090	1090	1040	1270	1440	1390	1420	1665	1730	
	Weight drops	1960		1870	1710	1470	1140	1140	1165	1240	1310	1610	1490	1500	1720	1900	
Sagging range to the drop under this weight		20		330	170	230	30	50	75	200	40	170	100	80	55	170	
Sagging range to normal melting point		20		330	210	250	160	50	202	252	70	170	215	100	205	266	
8 oz.	Sagging commences	1930		1400	1390	990	1090	1090	1020	1040	890	1340	1270	1270	1650	1620	
	Weight drops	1960		1845	1670	1310	1140	1115	1140	1220	1290	1500	1460	1490	1705	1880	
Sagging range to the drop under this weight		30		445	280	320	50	25	120	180	400	160	190	220	55	260	
Sagging range to normal melting point		30		470	360	500	180	50	272	252	450	270	335	250	220	376	
24 oz.	Sagging commences	1760															
	Weight drops	1960															
Sagging range to the drop under this weight		200															
Sagging range to normal melting point		200															

FIG. 3.

contraction be affected by twenty-four ounces actual pressure per square one-eighth inch. By adding two-tenths of one per cent. of aluminum to the gold its melting-point was materially reduced, viz., to 1870 degrees, and the range of temperature through which it is moved by the various loads increased several fold, or five pennyweights, moved the resulting alloy 280 degrees below its melting or fluid point instead of 20 degrees for pure gold, and an eight-ounce load, 470 degrees instead of 30, and a twenty-four-ounce load 600 degrees instead of 200. This alloy makes fair fillings, and being 998 parts in a thousand pure gold can hardly be detected from pure gold, except for being firmer. The further addition of aluminum does not improve this quality materially, while it produces a brittle gold rapidly; ninety per cent. gold and ten per cent aluminum, has a lower melting-point than pure aluminum, and lower than ninety-five per cent. aluminum and five per cent. gold, and an alloy of about one part gold and two parts of aluminum makes an alloy slowly, under continued heating, that has so high a melting-joint that it can, with difficulty only, be fused with a blowpipe. It is a poor brittle metal, and difficult to produce.

The table of metals and alloys (Fig. 3) shows the temperature at which the various pressures will move the mass.

Another method of establishing the effect of pressure on the control of the location of contraction was to make a chamber of fused quartz 25 cm. (10 inches) long, 1 cm. wide and 2 mm. across. The two opposite sides that were 1 cm. apart, were ground and polished straight from end to end, to within one ten-thousandth of an inch, which made the apparatus very expensive. The fused quartz for constructing it had to be made in Germany. A column of fluid pure gold freezing or cooling in this chamber showed the diameter at various distances from the top of the column, which gave the exact pressure without errors such as are introduced by the wax and investment method, and gave results that corroborated those reported above.

Controling Contraction of Metals.

Since gold does contract and we can, at best, only modify the location of part of the total contraction, we have only two alternatives; either to enlarge the mold as by expanding the investment, or produce an alloy that will not contract, except where we can hold it, making it stretch as a ring or staple over a form. This has been done in an alloy which, however, we can not use, viz.: Invar metal, composed of nickel 35 parts and a special iron 65 parts. This alloy has practically no expansion and contraction as compared either with nickel or iron. The writer has tried to make an alloy of gold that would have this property of nearly zero contraction and expansion on cooling and heating,

which could be used in the mouth and also having good casting qualities, but so far has failed. It probably will be accomplished by some one, and metallurgists should try to produce it. Our only methods available at present are to expand the pattern or investment or bolt and control the shrinkage as far as possible by pressure on the freezing metal, which combined methods will reduce the contraction fully two-thirds, and to hold the contracting gold. There are conditions where, by stretching the gold as it cools, the contraction can nearly all be controlled, as shown by these rings cast for this tapering column. When the gold is allowed its full contraction with a very soft investment, to retain the form of the ring, it will not pass nearer than to within about one inch of the base, while the wax form passed over the base. With an average plaster and silica investment heated to 800 degrees and moderate pressure, it passes to within half an inch of the base, and when cast over a hard model of the artificial stone it will slip over the base, because the pure gold could not contract, or, rather, was stretched as it did so. This will pass over the base, and will be referred to in casting crown bases, double compound inlays, etc.

Advantage of Model Methods.

Another fixed condition to which we must adapt ourselves and our methods, is a very confined, inconvenient space for making exact operations in, and all of the work that we can remove from that confined environment to where we may have freedom will add not only to the comfort of both the patient and operator, but to the exactness of that part of the work that pertains to contour, etc., provided we can readily remove unchanged all the data pertaining to the relations of parts, which we can very readily do with great exactness, as will be shown.

This is the great advantage of all model methods, and the speaker believes that in the near future a very large majority of all the inlay work will be done by some of the model methods. The requirements are that an impression be taken that will faithfully reproduce not only all the cavity surfaces, but the contiguous parts, so that all the involved relations can be faithfully reproduced outside of the mouth. There are two general divisions or kinds of model procedures. One provides for a model that reproduces the tooth and in which a pattern is made in platinum foil or wax, from which, when separated from the model, the inlay is made. The other provides that the filling or inlay be made directly in the model itself, thus eliminating two steps. To the former class belong the fused metal and sulphur and amalgam models which are good as far as they go, but do not allow of casting or fusing the filling directly into them. The other is a hard model that reproduces the teeth and structures with equal faithfulness, but also allows of casting or fusing

the gold directly into it, and in which the inlay is polished and practically completed except for the final finishing of the margin when cemented into the cavity. So far as I know, there is only one such hard model as the latter calls for, viz., the artificial stone suggested by the writer. It is a silicate cement and uses phosphoric acid as a liquid. Unlike the silicate cements, it does not have contraction on setting and can be heated to and above the melting-point of gold without contraction on cooling again. It expands to about eight-thousandths at dull red heat and requires some heat to make it become stone hard. I have developed some improvements in the methods for making it since I reported before.

It is a silicate cement with the essential difference that it does not contract on setting nor again on being heated, even to a high temperature. Practically all the silicate cements contract as much as forty thousandths of their dimensions on being heated even dull red and fuse far below the melting-point of gold. It was extremely difficult to produce a substance that would not contract after being heated and that would sustain such a temperature. This is the only substance that is moldable and hard and strong that the speaker knows of that will do it.

Exceeding great exactness of formula and fusing temperature are necessary to produce a constant material that will not contract, when mixed with its acid, more than one-thousandth of its dimension. In any formula the variations in the chemical consistency of the ingredients must be met by varying slightly their proportions. A good kaolin, three parts; calcium hydrate, one part, and aluminum oxid, one part, by weight, thoroughly ground together wet, and burned to about 2750 degrees F., produces, when ground again without contact with iron, a good foundation. This is mixed, when finely ground with best quality potshell, equal parts. The fused mass above has extreme hardness and is very difficult to powder. No two kaolins have exactly the same chemical proportions, which makes careful adjusting of the above formula, to the material used, necessary. This does not make so white a model as a result obtained in a synthetic manner by a formula I have developed of the following contents:

Pure silica	20 parts
Calcium hydrate	19 parts
Aluminum oxid	42 parts

The purity of the calcium oxid will determine the exact amount of it required to produce a stone of zero contracting quality. This is also, when powdered without contact with iron (for the slightest trace produces frothing and gas bubbles), mixed with the finely powdered potshell, and the whole mixed and powdered to go through at least a 200-

mesh sieve. The acid may be prepared most easily by boiling slowly a good quality of ortho-phosphoric till it ceases boiling and fumes cease to be given off, though still syrupy, and not turning either brown or white. It is then diluted after cooling to about 45 3-10 degrees Baum specific gravity and brought again to boiling-point. The addition of modifiers to the acid, in nearly all cases, lowers the fusing-point of the resulting artificial stone.

I will be glad to assist any manufacturer who will provide the materials in good quality to the dental profession. Anyone can make the trays, having a good quality of heavy, hard brass. The wax is made by melting together, dry, a

Pure white gum dèmar...	110 parts
Tamarack (hackmatack)	10 parts
Beeswax	15 parts
Paraffin	10 parts
Stearic acid	2 parts

In the orders given and without contact with water, which injures the quality.

The making of an inlay by the wax-pattern method and casting involves three transfers of the cavity surfaces, viz., (1) the tooth to the wax, (2) the wax to the investment, and (3) the investment to the gold, and the inlay is thus three steps removed from the tooth. With the fused metal model or sulphur model, or amalgam model methods, the cavity surfaces have been transferred five times, viz., (1) the cavity to the impression, (2) the impression to the fused metal, sulphur or amalgam model, (3) this model to the wax pattern, (4) the wax pattern to the investment, and (5) the investment to the gold.

The stone-model method cuts out two of these steps and transfers of the cavity surfaces, and, like the wax-pattern method, is only three transfers of surface removed, viz., (1) the cavity and tooth surfaces to the impression, (2) the impression to the stone model, (3) the stone model to the gold; but it has many distinct advantages, some of which are as follows:

Advantages of Artificial Stone Models.

(1) The wax which takes the impression of the cavity is supported at every point by more hard wax, which in turn is attached to the tray and its metal septum, passing between the teeth, in case of an involvement of the contact point, thus entirely eliminating the making of exact wax contours and margins in the tooth cavity.

(2) The margins and contours of the filling are made with hot wax on a dry model held in the hand with the approximating tooth removed or replaced at will and besides, with no moisture, blood, gum tissue, cheek or tongue in the way to prevent viewing and forming a normal contour and margin, or to prevent the manipulation of the wax to that ideal.

(3) The septum of the tray and the wax it carries with it presses the gum tissue temporarily away from the gingival margin of the cavity.

(4) The model reproduces the contact point of the approximating tooth and permits of exact and definite adding to the new gold contact point to reproduce a more perfect anatomical interproximal space, secured by slight separation with a temporary filling.

(5) The stone model is very strong and hard, and when the gold is cast against it (for the stone model with its wax filling is invested and thus becomes a part of the investment) the cavity surfaces are not distorted, which occurs in large measure with all plaster and silicate investments with any but an extremely low pressure.

(6) The stone model gives the tooth surfaces and contours beyond the cavity margins, which allow the polishing of all surfaces and contours of the cast or fused gold inlay while in its normal environment, making an extreme exactness of normal contour possible.

(7) The cavity margins can not be bent, spun or distorted in polishing.

(8) The heat of polishing does not hurt either the patient or operator, nor can the inlay fly, as it is held securely by the model.

(9) For simple cavities without much contour to be reproduced, the inlay can be very quickly made by fusing directly into the model (described later).

(10) Several teeth involving several adjoining contact points can be restored at once with great exactness.

(11) It is extremely simple on the stone model to reinforce with iridio-platinum all places where pure gold is not ideally strong.

(12) Inlays hollow to any extent can be simply made by adding new soft stone to the stone cavity before waxing.

(13) The stone model is so strong that any desirable pressure can be used without distorting the cavity surfaces which occurs with the plaster and silica investments materials.

(14) Porcelains, except high-fusing, can be fused into gold or gold and platinum foil while on the stone.

(15) The stone models can be reheated at will even after being thrown hot into water, making it possible to assemble bridges and orthodontia appliances and build them up in sections.

(16) Any skilled assistant can make the models and wax, and articulate, and cast or fuse the inlays and polish them with exceedingly great exactness, as well as the operator.

(17) The patient is saved much time and discomfort, and besides should have a restoration fulfilling very high ideals; higher than by most methods.

(18) The operator increases his ability to serve and, therefore, to earn, besides making more perfect restorations.

Technique of Making Stone Models.

The method of making a stone model is as follows: Mix the powder and liquid to about the consistency required for a silicate cement, filling and insert carefully into the dried wax impression with a small pointed spatula. A steel spatula can not be used for mixing, owing to the formation of gas bubbles; use instead nickel, German silver or bone. As soon as the stone is set enough to hold its own weight without flowing, it is placed over a burner and the wax of the impression melted off, but not pulled off as with compound. By the time the wax is all melted off the stone is strong, but not hard like earthenware, until heated dull red with the blowpipe. The model is black from the carbon of the wax until heated red, which makes it white.

If the mix is too thick when placed in the impression, it will be difficult to prevent entrapping air and will also make a weak model by being laminated instead of homogeneous. It should run very slightly in large quantity on the spatula or slab, but not soft enough to drip, when mixed properly. The impression must be thoroughly dry when the stone is put into it, and small quantities must be placed into very deep parts of the impression first, with the small point of the inserting instrument. The same care must be taken as when painting an investment onto and into a wax pattern for an air-bubble or disc on any cavity surface makes the inlay that much too large and prevents it seating. Any assistant can with a little practise make the models.

If porcelain is to be baked on the model, the wax must be all burned out first, making a white model, otherwise the carbon from the wax will discolor the porcelain.

Cavity Preparation for Inlays.

The preparation of cavities is so important as to determine quite largely, before the impression is taken by any method whatsoever, whether the operation will be a success or a failure. To say that a cavity should be prepared so an impression will draw, only makes it fulfil one of the crudest and simplest requirements of the fixed conditions. The physical properties of the gold and tooth substance; the established fundamental principles of carrying cavity margins

to immune areas; the anatomical relations and the physical stresses to be sustained, all unite to establish the fixed conditions which, of necessity, control in general the ideal preparation of each and every cavity.

Beveled Margins.

Since gold contracts to a considerable extent on cooling from the liquid state, which can not be entirely corrected or prevented, and since it is impossible to make cavity surfaces of the gold perfect in smoothness, it becomes necessary for these and the reasons established by the fixed conditions, that we utilize the malleable or moldable quality of gold in order that we may produce margins of the high ideal we have taken for our standard, viz., the gold in close adaption to the tooth without a visible cement line at any point around the margin. Such margins can not be made all around an inlay having butt joints coming at right angles to flat surfaces. We must bevel every margin that does not naturally meet the surface at such an angle as to permit the gold being burnished and finished tightly to the tooth. The strength of the margin makes it imperative that we do not make thin knife edges, but rather like the edge of a chisel. Such a margin can be burnished closely to the tooth while the cement is still soft, provided the metal is pure or nearly pure gold. This method of preparation is particularly indicated at the gingival margins where, of necessity, a butt joint can rarely, if ever, make such a margin as our standard requires. The fulfilment of the requirements of extension for prevention removes enough of the tooth structure to allow of the withdrawal of an impression from approximal surfaces where the contact points are to be reproduced, and very often there will be a decided saving of tooth structure for an ideal inlay preparation as compared with the ideal preparation for a malleted filling.

The strength of the inlay in resisting the stresses of mastication make it essential that we do not depend upon the cement for retention, but rather prepare all cavities with a dovetail locking step, or a locking post, and depend on the cement to prevent the inlay backing out of the locking seat. The detailed application of these fundamental principles of margin preparation, of carrying margins to immune areas and the mechanical locking of all inlays will be demonstrated with illustrations for the various cavities.

Taking Impressions of Cavities.

A first requisite for the taking of impressions with any plastic is that it be supported equally at all points to and beyond all areas to be accurately reproduced. This makes a variety of forms of trays necessary for the large variety of cavities met with. These can best be illustrated in connection with the individual cavities. Great care must be exercised that trays be made of a very stiff material,

otherwise the impression wax will spring it when it is pressed over the tooth or teeth, and when removed the spring of the metal will slowly but surely distort the impression. The impression material should be as stiff at the base of the impression as can conveniently be pressed to place, and very soft on the surface to allow it to be pressed into every crevice. For very difficult cavities with margins extending below the tissues, it is often of great advantage to use the first impression as a tray and after drying place a fresh surface of hot impression wax in it by dropping from a heated stick. The first mass, the cold, hard impression carries the second of warm, soft material into every crevice even far under the gum tissue where possible.

The impression material used for making artificial-stone models must be free from inorganic substances and must be such as will melt clean from the stone without injuring the surface.

The ordinary impression compounds are not suitable, and for this reason a proper impression wax is furnished with the stone. A dry heat must be used to remove the wax from the stone, and if it is desired to save the wax a dry water bath can be used and is made very simply by placing a dry cup or tumbler in a basin of boiling water. After the wax has melted off, the model should be hardened by being placed in a large flame which has an excess of oxygen or air. This will burn up the wax without smoke. The warming of the special wax provided to be used with the stone is best accomplished by placing a wafer of proper size in some very warm water and soften to about the toughness of stiff leather; at the same time moisten the fingers so that the wax will not stick to them. Fold the wax over and over, preferably slightly heating the folding surfaces as they come together, in a gas or alcohol flame. Place in the dry tray previously selected, at which time it should be quite resistant to pressure. Heat the surface in the flame and, after drying the excess of water from the cavity with a blast of warm air, press to place. The impression should not extend into needless undercuts. While supporting the tray with one finger place the saliva ejector in the patient's mouth and throw a stream of cold water on to the impression. When it is partially chilled withdraw part way from the cavity to remove extensions that may have protruded into adjoining interproximal spaces and press again to place and chill, and remove. If there is uncertainty as to whether the cavity is free from undercuts, place the impression back into the tooth once or twice to plane off any possible points where it has drawn. Special points in impression taking will be brought out in connection with the different cavities.

Simple Occlusal or Buccal Cavities.

The detailed technique for applying this method to the various cavities will be taken up in detail beginning with the most simple: First, simple occlusal or buccal where there are no difficult contours to replace. Use cross-cut taper, fissure burs for the preparation, cutting out all involving fissures. Bevel all margins, preferably with a small vulcarbo stone such as the hub of a vulcarbo separating disc. The simplest tray for supporting the wax for taking the impression of such cavities to and beyond all surfaces required to be accurately

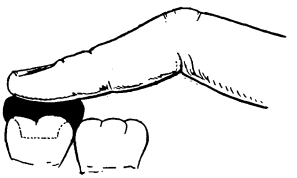


FIG. 4.

reproduced is the finger, as shown in Fig. 4. Heat a piece of wax in the hot water, as directed, and, after folding into a stiff cone, heat the base of the cone just a little to make it sticky; partially dry the forefinger and place the base of the cone upon it, then drive the excess of water from the cavity with a short blast of warm air, and after warming the tip of the cone quite soft press it into the cavity and chill with the stream of cold water after placing the saliva ejector. The part of the wax within the cavity may not be quickly chilled hard enough to prevent it being distorted when the impression is removed, so loosen the impression, and after the cool water has reached the cavity, press it back into the cavity to place once or twice to make sure of no distortion. There are two methods for making the gold inlay for such a cavity, viz., fusing and casting, but for either method the stone model is made in the same way. After mixing the stone on a slab to about the consistency of a thick porridge, place it into the thoroughly dried impression, being careful not to inclose air. If it is desired to make and complete the operation immediately, use the fusing method and place the freshly mixed stone directly on a wire gauze plate over the edge of a bunsen flame and heat, at first slowly, to harden the stone and let the wax drop off into any provided receptacle.

There are bunsen burners supplied by the dental trade provided with a drip dish about the burner. The model should be heated in the direct

flame until the wax takes fire, which it will do and burn without smoke in a large flame, having an excess of air. After removing the model from the flame place over it either thin soft platinum or, much better, "Rowan's" gold and platinum foil, shade 2 or 3, and after pressing the center into place with a roll of cotton, use a piece of unvulcanized rubber with a sheet of rubber dam around it and press the foil into close contact with the cavity walls and margins. If the gold and platinum foil is used take a piece twice the size of the top of the tooth and after annealing fold once, which makes a good strong lining for the cavity and adapts very closely. After adapting the lining melt blocks of pure gold into the cavity directly into the stone with a blowpipe. The lining will draw the pure gold up over all margins and no flux is needed.

From the time the impression is taken, the whole operation, making the model, burning off the wax and melting the gold seldom requires over ten or twelve minutes, even when done in a clinic with improvised conveniences. The inlay is trimmed with a stone and polished while on the stone model where it was made and with very great exactness of contours, for the model gives the contours and surfaces beyond the margins, which a simple cavity pattern does not. Usually simple occlusal cavities carry out the normal contours of the natural perfect tooth, and do not require a special contour for the antagonization. This will be almost universally true for all young people and for such cases no bite is required.

The making of an articulation record or occluding model will be described later. If on placing the inlay into the cavity and letting the patient bite, it is too full, the surface will show a mark and the inlay will be placed back in the model and ground, and, in so doing, it can not fly or be distorted, or cause discomfort from heating. The locking of the inlay is secured by grinding cross-cuts around the part which goes within the cavity and into which the cement forms an anchor key. In certain cases of excessive strain on inlays, as bridge abutments, similar grooves should be cut into the cavity wall. The inlay should be set with a very slow setting, soft hydraulic cement, ground very fine and the margins should always be finished to the tooth while the cement is still soft. For the reason that the most perfect margins can only be secured by burnishing and spinning a malleable metal to the tooth wall, we should use a pure, or nearly pure, gold for inlays. The hubs of vulcarbo separating discs are especially good quality of stone for finishing the gold to the margins and should be run toward the enamel to drag and flow the gold to the tooth. In some cases a fine gold finishing bur is very efficient. Follow these with a fine cuttlefish disc and finally burnish with a polished steel burnisher;* pear or oval shapes are most convenient. The burnish-

*The new burnishers, made of tungsten, are vastly superior to steel.—Ed.

ing hardens the surface of the gold. Such margins properly finished, as directed, can not be detected from the very best malleted and most exquisitely finished fillings, except that they keep their surfaces better.

The other method for restoring such a simple occlusal or buccal cavity is by casting directly into the stone cavity as follows: After melting and burning off the impression wax, cool the model and proceed to wax up an ideal filling in the dry stone cavity, using any base plate wax, preferably one not colored, for the advantage of transparency. Use a hot instrument and melt and mold the wax to the stone. Attach a pin and sprue gate to the wax at any point and invest the whole model with its waxed filling in a casting ring, using any cheap strong silica and plaster investment. About four parts by weight of a suitable silica to one of plaster is good. Dry and burn out in the ordinary way, except that there can be no damage done to the cavity surfaces by rapid heating since they are very strong, being entirely in the stone model part of the investment. Cast with any method directly into the stone cavity and use as high a pressure as desired. The higher the pressure the less the contraction by the forcing of new gold from the sprue into the cavity as the gold in the cavity recedes by contraction, as explained in detail earlier in this paper. To have the pressure effective the sprue neck must be large and the investment hot. Too small a sprue neck with any method of pressure prevents movement of the congealing gold by the chilling of the gold at that point. When casting with air pressure or suction machines, always mount the inlay on the sprue so that the mass of the inlay is below the point of attachment and trim away any parts of the model that extend outward below the inlay, thus cutting off the pressure on the margins that would otherwise be in pockets in the stone model. With a centrifugal force this is not necessary.

Inlays cast into the stone model with low pressure will be easily removed, and when fused in with a blowpipe, as directed, will drop out, while those cast with high pressure will always be so tight as to necessitate the breaking of the model to get them out. The difference is due to the control of the contraction of the inlay by pressure on the sprue. The hot casting ring containing the stone model is thrown into cold water to chill after casting (water does not affect the stone after it is heated), and after washing off the plaster and silica and cutting off the sprue gate it is ready to polish. This is done as with the fused inlay while it is in the stone model, with stones and discs. To remove the polished inlay from the model when cast with high pressure use a pair of knife-edge cutting pliers, like wire-cutters or wedge-cutters, and split the model in such a way as not to bend the inlay. It will usually shell out clean and bright like the meat of a nut, but if any pieces stick to it use an exca-

vator to dislodge them. Be very careful to look for any possible beads on the back of cavity surface caused by air bubbles caught in the stone when mixing or inserting it. These are easily seen and if not removed would prevent the inlay going to place. Inlays to fit inside dimensions, when cast into the stone, will fit the cavities more tightly than when fused, and vice versa when intended to fit outside dimensions. Grind cross grooves in the cavity surface for the cement to lock into and anchor the inlay and set and finish as directed for the fused inlay. Any ordinary assistant can soon learn to do any or all the work of making the inlay from the time the impression is taken to preparing it for setting.

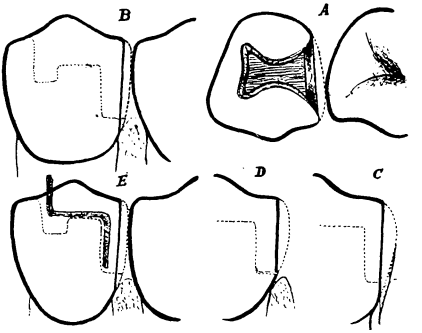


FIG. 5.

Simple Single Approximal Cavities.

We will now consider the restoration of the simple single approximal cavity. The cavity preparation for anchorage and prevention of return of caries requires a seat in the occlusal and removal of the contact or approximal surface sufficient to carry the margins to immune areas. This preparation can, if properly applied, give all surfaces and margins in such relations that if cavity undercuts are filled they can be faithfully reproduced in an impression, provided the impression material is supported properly at all points. The two weak points of approximal fillings are the gingival margin and the anchorage. Both can be made very strong if the cavity is properly prepared. The fixed conditions are established, that to make all margins of every cavity of the high ideal selected, we must use the moldable or bending quality of pure, or nearly pure, gold and burnish the chisel edge or margin into very close adaptation at every point while the cement is soft. To be able to do this we must prepare the cavity accordingly, and with greatest necessity at the gingival margin. When the contact surface is removed sufficiently to carry the buccal and palatal margins to immune areas there

is room to pass a thin separating disc between the teeth and prepare that important gingival margin, as will be seen in any of the illustrations of approximal preparation. The bevel at the gingival margin should if possible, for immunity, be carried just under the free margin of the soft tissue. The floor of the cavity does not require to be carried to the edge of the soft tissue as for an ideal preparation for a malleted filling. If the decay does not involve the tissue to be used for the step, much less will need to be removed at that point for a given strength with the inlay than for a malleted filling, provided the reinforcing bars are used in the step

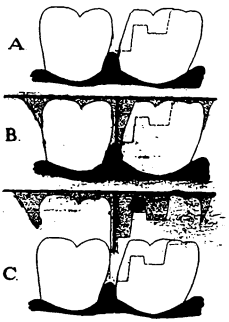


FIG. 6.

when casting, as directed later. If every margin should end in a chisel-shaped edge, that must be provided for in the preparation of the cavity. Figs. 5a and 5b show two views of good bicuspid approximal preparations. Fig. 5d shows the usual inlay butt joint at the gingival margin and is very bad preparation, for it is impossible always, if ever, to make with that preparation a margin there having the high ideal we have adopted. Use crosscut taper fissure burs and small stones for the preparation of the step and its margins. The taking of the impression has one apparently very serious difficulty, viz., the undercut under the contact point of the adjoining tooth, which will distort any mass, being drawn unprotected from the cavity and interproximal space. This can be prevented quite perfectly by means of a septum on the tray, which extends between the teeth to the gingival tissue, as shown in Figs. 6a, 6b and 6c; 6a shows the cavity preparation and the relation of contact point of the adjoining tooth; 6b shows the tray with the wax on both sides of the septum in the tray and pressed to position as when taking the impression, and 6c illustrates how the wax, under the contact point, is drawn off and is not able to distort the impression of the cavity because the surface is

completely protected by the septum as the tray is withdrawn straight outward from the cavity. The septum also has the great advantage of pressing the soft tissue out of the way to permit an impression of the otherwise difficult gingival margin.

The distance to the gingival margin varies greatly and accordingly trays have been made with the following different lengths of septums, 3-16 inch, 4-16 inch, 5-16 inch, 7-16 inch, and care should be used in selecting the tray with just the proper length of septum for the case to just press the soft tissue without cutting it. If the cavity is prepared without undercuts, or with the undercuts filled, and if the impression wax is quite stiff next to the tray and quite soft on its surfaces, and after placing in cavity is started a little and replaced before it is hard and then well-chilled with a stream of cold water before removing it, you will make a very faithful reproduction of the cavity and margins. If the impression is carried beyond the gingival bevel, the bevel at that point will show to extend to the end of the impression. Make a record of the width of the bevel below the gingival floor, either by marking it on the impression with a scratch line on the wax to be reproduced on the stone model or by noting the distance below the floor and wax and finish to that record. If this precaution is not taken the contour of the inlay may be waxed and cast, as shown in 5c, where the contour of the approximal surface is carried too far under the gingival tissue and must be removed before setting, otherwise a most irritating and defective gingival margin would result. The impression is filled with the stone and the model made as previously directed.

If a record of the occlusion is required, have the patient bite into a small warmed piece of base-plate wax placed over the cavity. This is placed on the model in the same position and after wiping the surface of the model at each end beyond this wax with vaseline, to prevent sticking, place some freshly mixed stone into the prints of the cusps of the antagonizing tooth, letting it extend on to the vaseline surfaces of the model for contact. Place the whole over the flame and in a few moments it will be hard and the wax bite melted off. This makes a very quickly made model articulator and, particularly in compound or multiple restorations, is of great convenience and accuracy. Almost invariably when the contact point is gone the natural anatomical interproximal space is destroyed by the teeth closing together, which space should be secured again by placing in the prepared cavity a temporary stopping filling for a few days. To preserve the space will necessitate an addition of gold on the contact point of the inlay. To secure this definitely, we will polish a little off the contact-point of the approximating stone tooth which has become a part of our model. We will also polish off a couple of thousandths of an inch

extra to allow for polishing the gold of the inlay. The cavity may now be waxed up with a warm instrument, though usually it is best to divide the model between the teeth, thus giving very perfect access to the gingival margin. To separate the model, use a fine jeweler's saw and start a cut and then with the fingers or a pair of excising forceps fracture through. After waxing up the cavity press the two pieces together in their exact relation, as shown by the fractured surfaces articulating together, and thus produce a very exact contact-point. The normal contours of the tooth

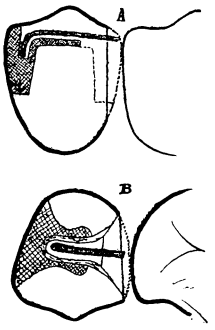


FIG. 7.

are shown by the model and the waxing can be done with extreme accuracy, producing more perfect ideal contours for the anatomical conditions as they exist than can usually be done with a matrix and polishing and shaping contours of malleted fillings in the mouth.

If greater strength is required in the step, run a piece of round iridio-platinum wire through the die-plate and thread it and cut and bend a piece to set in the step, as shown in Fig. 5e. This is placed in the cavity before waxing it and an end is left, as shown, extending about a sixteenth of an inch beyond the model to engage in the investment which will hold it in place when the wax is melted out and the molten gold is going in to chill around it. This makes very little cutting necessary in the step for a very strong anchorage. If there is already a good filling or inlay in the other approximal or the occlusal surface of the same tooth, this method makes a very simple and strong means of locking the two together, as shown in Figs. 7a and 7b. A groove is cut across the occlusal of the fixed filling and a hole drilled into the strong part of the mass. A piece of the threaded iridio-platinum bar is bent to fit into the hole and lie where it will be in the mass of the new inlay. The impression is now taken over this and the bar comes away with it. When the stone is placed in the

impression and the model removed from the impression by melting the latter, the bar is in place in the model as it was in the tooth. Wax up the cavity over it and cast around it. It can not move because the end that was in the hole is anchored in the stone model. All inlays are polished on the model in practically the same manner. Be particularly careful with the gingival margin and contour.

The writer usually takes two impressions, which only takes a few moments, and for no other purpose than the advantage to the assistant of having a second model of the cavity before him when polishing the gold inlay in the first model to show where the cavity margins are and to allow of practically complete exact shaping and polishing on the model

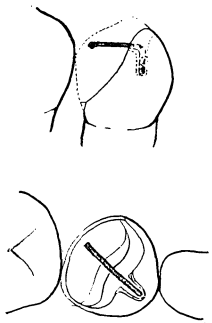


FIG. 8.

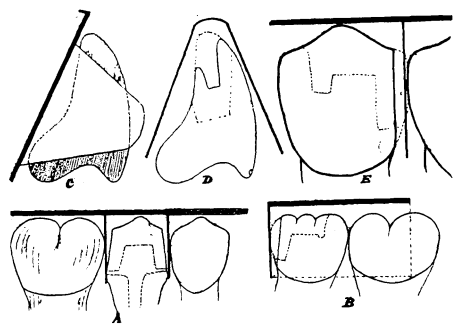


FIG. 9.

before fracturing it. The advantage of the stone model for final shaping and finishing of normal contours is very great.

After removing such normal inlays from the model, by fracturing it with a pair of cutting-pliers or forceps, crosscut the back of the inlay with a thin-edged stone and look for any beads of gold from air-bubbles, and if the mass of gold is large and lies near the pulp, grind off sufficient to give a good cement lining between at that point. Place in the cavity and burnish carefully to all margins and look particularly to see that the gingival margin has not been contoured and extended too far, as shown in Fig. 5c. Cement with a very slow setting cement and finish all margins to the tooth while the cement is still soft. A cement that sets too quickly for doing this makes such margins as we have taken for our ideals impossible. After spinning all the accessible margins to the tooth with the stone and disc, the gingival margin must be finished with hand instruments which, however, can be done very accurately and

quickly if the gingival margin is not left extending beyond the gingival bevel which is easily corrected if looked for before cementing. Use fine draw-cut files or finishers and burnishers. The D. D. Smith prophylaxis scalers make excellent inlay trimmers and finishers for the gingival borders if you have no better. The writer has designed simple convenient forms that reach all surfaces and angles easily. They can be obtained through any of the dental supply houses and are made by the Cleveland Dental Mfg. Co. They include file-cut trimmers in pairs so designed as to reach the gingival margins of all teeth from both inside and outside. Also long-taper rotary finishers for the same purpose for use in the handpieces.

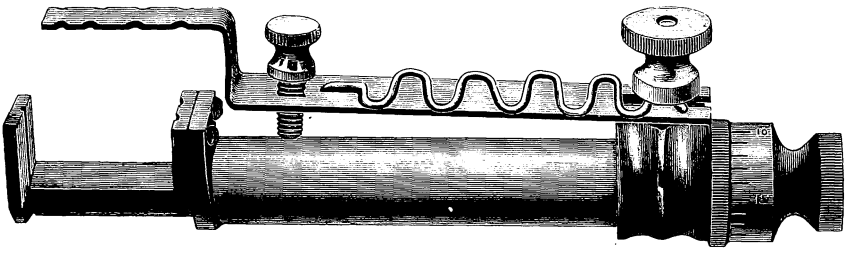


FIG. 10.

Anchorage with Bar.

The principle of anchorage by means of a bar, around which the inlay is cast, is very applicable and with great advantage for badly or partially broken-down teeth, as cuspids, where no retaining walls are left, as shown in Figs. 8a and 8b. In such cases the threaded bar is placed in the hole in the tooth and is allowed to come away with the impression, as in Fig. 7. This makes a very strong anchorage, with exceedingly little loss of tooth structure. Any of the cavity restorations considered so far are very simple compared with the double compound restorations in bicuspids and molars, because the uncontrolled contraction, or that not compensated for by expansion of the investment, does not draw it away from the pulpal walls, but by the shortening mesio-distally makes the inlay, which is the shape of a staple or horseshoe, too short to go over the occlusal surface, and when forced down pries out the gingival borders. Such compound restorations, well adapted, give excellent reinforcement to otherwise frail teeth, and are infinitely better than the abominable mother-hubbard gold crowns so often placed on

them. The stone model is of particular advantage in this form of restoration because its strength is sufficient to hold the pure gold when cooling over it, and thereby causes it to stretch mesio-distally, prevents the shortening. A great saving of tooth structure is secured across the occlusal surface if the threaded iridio-platinum bar is used in the form of a staple lying over the pulpal walls. The tray used for such a case is shown in Fig. 9a. It has two septums; they are adjustable in their distance apart so that it can be used for bicuspids or molars of any size. It is made of different lengths of septum, 3-16 to 7-16 of an inch.

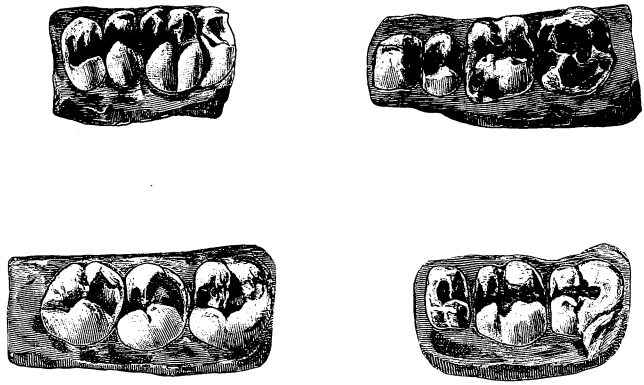


FIG. 11.

Restoring Adjacent Lost Contours.

Where the contact or approximal surfaces of two teeth have to be restored at once a new difficulty is involved. The impression is taken in the same way and by a similar tray as for single approximal restorations. The new difficulty lies in the fact that since both contact points are gone and are to be restored we can not take from either to get the extra space for making the other as we did in the case of the single approximal restoration where we polished from the stone contact-point of the approximating tooth to get the extra gold to make up for the separation secured by the temporary filling and for polishing to get a good finish. This can be done approximately by fracturing the model through between the teeth and waxing up the contact-points with an excess, as shown by articulating the fractured surfaces. It can be done very exactly by means of a micrometer articulator, shown in Fig. 10. In use the soft stone model in the impression is placed between the vaselined jaws to set. When sufficiently set the model is

removed and heated and broken through between the teeth. The occlusion is secured by the bite in base-plate wax, as described and in these instruments the antagonizing model is attached, when the stone is setting, to a movable arm which has all the movements of mastication. The micrometer articulator has a micrometer screw that moves the jaws to or from each other with a scale on the revolving head reading directly in thousandths of an inch. The position of the jaws is noted when the separated pieces of the model are in contact. The model is removed and the cavities waxed up normally with a little excess of wax on the contact-points. The two pieces of the model are now placed in the articulator and the micrometer screw turned until the two are within, say, eight-thousandths of their normal relation. That is an allowance of two-thousandths for each surface for gold to polish to get a good finish and two-thousandths for each surface for separation by the temporary filling. The occlusion is then adjusted by pressing the occluding model into the wax filling, it being mounted on the articulator. When these fillings are cast and finished they will usually go to place with good normal pressure at the contact-points. The writer frequently makes several adjoining restorations at once with great accuracy by means of this instrument. Note that where temporary fillings are pressing on both sides of the same tooth as where several contact-points are to be restored at once there will be no movements of that tooth, so in cases of several adjoining restorations being made at once from one impression, only the end teeth can move. Fig. 11 shows several models where several contact-points were restored at once. One case had six contact-points. This can only be done where there are no undercuts to prevent getting accurate impressions.

Disto-Occusal Cavities in Third Molars.

The cavities involving the disto-occlusal surface of the third molars require a tray like a box with three sides, as shown in Fig. 9b. The end of the box acts as the septum of other trays to press the tissue away from the gingival border of the cavity. The cavities in the incisors and cuspids usually require a compound impression, there are some, however, that can be taken in a simple direct impression, as illustrated in Fig. 9d, which also illustrates the form of tray used. The use of the strengthening bar, as directed, will often allow of a saving of tooth structure in the incisal step where the strain is very great and the tooth tissue very limited.

It is only when cavity walls are parallel to the tooth walls that both can be reproduced in one impression. When, however, the approximal cavities of cuspids and incisors are entered from the lingual surface, as

they should almost always be (see Fig. 12), and should have good locking form, as described later, the cavity walls are at nearly right angles to the tooth walls, and since the impression of the cavity must be made in the direction of its walls only the lingual surfaces of these teeth can be produced with the cavity impression which leaves the labial surface and margin of the cavity absent. This difficulty is very completely overcome in the following simple manner by a two-section impression. A tray with a very thin septum is used, the shape of which is shown in Fig. 13a, and in position in Fig. 9c, without the impression wax on it,

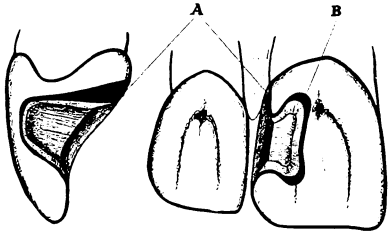


FIG. 12.

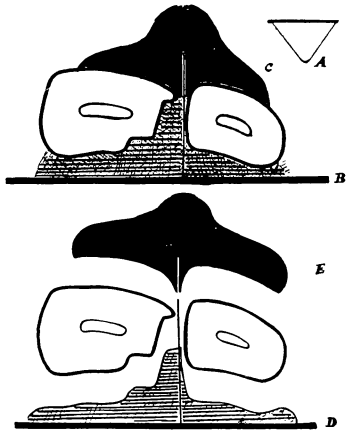


FIG. 13.

and in a cross-section view with the wax on it in Figs. 13b and 13d. The tray, with impression wax on both sides of the septum, is placed in position from the lingual surface and the end of the septum passed through between the teeth and while being held with the finger, the soft wax adhering to the protruding part of the septum is all scraped or pushed off, exposing it and all the labial surfaces of both teeth and particularly the labial margin of the cavity, shown in cross lines Figs. 13b and 13d. The wax is chilled with a stream of cold water and the impression partially removed from the cavity to insure that all the wax has been removed from the labial surface on the septum. It is then pressed to place again in the cavity and chilled with a stream of cold water and a second small cone of wax, quite tough at the base and soft at the point, pressed over the cold, wet septum and the labial surfaces of the teeth and the impression and tray projecting at the end and chilled thoroughly. This is shown in cross section in black, Figs. 13c and 13e. After chilling, the labial piece

is removed, and then the tray with the lingual and cavity surfaces, and, after drying, the two pieces are placed together and fastened with a hot instrument or sticky wax and the model made in the usual way. After casting and removing from the model, the short bevel on the labial margin is raised slightly to permit the inlay to pass into place, and after the soft light-colored cement is in place, that margin, with all others, is burnished down and finished to the tooth, as directed. This operation can not be detected from a malleted filling except for the lighter color of the tooth from the cement under the labial wall. The preparation of these cavities requires that the cavity be cut, either dovetail from the lingual entrance or with a step and locking pit or groove on the lingual surface, and special precaution should be taken to bevel well the gingival margin, particularly toward the palatal angle of the proximal surface (see Fig. 12a). The writer believes this to be the strongest filling that can be placed in such cavities as well as the most esthetic. Two approximating cavities can be filled at once as conveniently as one.

Hollow Inlays.

In all the cavities considered and also for the restoration of such broken-down teeth as have only a part of one wall remaining, it is often desirable or essential to make the restoration hollow. With the wax pattern this is accomplished by removing some of the wax from the cavity surface. With this method it is done by painting some freshly mixed soft stone over the surfaces of the stone model that are to be made hollow. This can be done with great exactness on the model and no heat need be applied to this freshly applied stone, since the heat of drying out the investment and melting out the wax is sufficient to harden it. In the compound approximal cavities involving both approximal surfaces and the occlusal of the same tooth it is of especial advantage to place a thin layer of new stone over the pulpal walls extending quite near to the margins which places all the pressure due to the mesio-distal contraction of the gold entirely on the margins, the only place it is necessary in any cavities.

Angles of Incisors.

The very small incisal angles that are not too conspicuous for all gold are very easily and strongly restored by drilling one small post-hole and inserting a small threaded iridio-platinum wire or post and taking the impression directly over it. The post comes away in the impression and is again transferred to the model as it is made. Wax up over the post and cast and polish. If, however, there is considerable of the angle gone, the gold will be too conspicuous and in such cases, whether the anchorage is by a post or by the dovetail and step preparation, as in Fig. 12, wax up the angle with a cavity in the labial face and

cast in gold or gold and platinum. The advantages of making these angles on the model are very great, for the operator has the adjoining teeth in place as well as the one involved, and the normal contours can be made very accurately and quickly. After casting and polishing, there are two methods of making a porcelain inlay in the exposed labial face. The simplest way is to bake a low-fusing porcelain directly into the cavity in the gold, or gold and platinum, while the inlay is still on the model. The disadvantages of this method are that the contraction of the gold and porcelain or gold and platinum and the porcelain being different there is great danger of the porcelain checking from the stress, though it may not show for six months after. Another disadvantage is that the yellow color of the gold will show somewhat through the porcelain unless it be a very dark tooth. If the tooth should be light it will be practically an impossibility to match it in this way. The writer has come to setting practically all these cases before making the porcelain inlay for them, and polishes away the gold line next to the enamel margin, and matches the porcelain direct to it, and bakes it in a platinum impression, and then cements it into the gold inlay.

All-porcelain angles for these cases have not proven to have sufficient strength, though they look well. All-gold angles have the strength, but have not a tolerable color. This combination gives the strength of the all-gold and the esthetic effect of the all-porcelain. These are exceedingly satisfactory restorations.

All-porcelain restorations are easily made, either by placing over the prepared cavity and tooth very thin platinum foil about one ten-thousandth thick and taking the impression over it. When the model is made the platinum will cover the cavity surface as it did the cavity of the tooth. The porcelain is baked directly into the platinum foil while it is on the model, and the advantages are that the surrounding surfaces and contours are present to guide in reproducing a normal contour which is extremely difficult if the platinum matrix is removed alone to build the porcelain into. Another way is to take the impression of the cavity and tooth, and after reproducing in the model, burnish the thin platinum foil to the stone model and bake the porcelain in it while it is on the model.

Crowns and Bridge Pieces.

For casting crown bases and bridges, the stone model is extremely useful. First, in the casting of abutments it has the advantages that the normal contraction of root foundations and crown bases is laregly prevented, for the gold cast where it surrounds the stone is held from contracting unless in too large mass, when it will crush the stone. This quality is of particular advantage in casting gold partial or full plates where there is much total error from contraction because of the

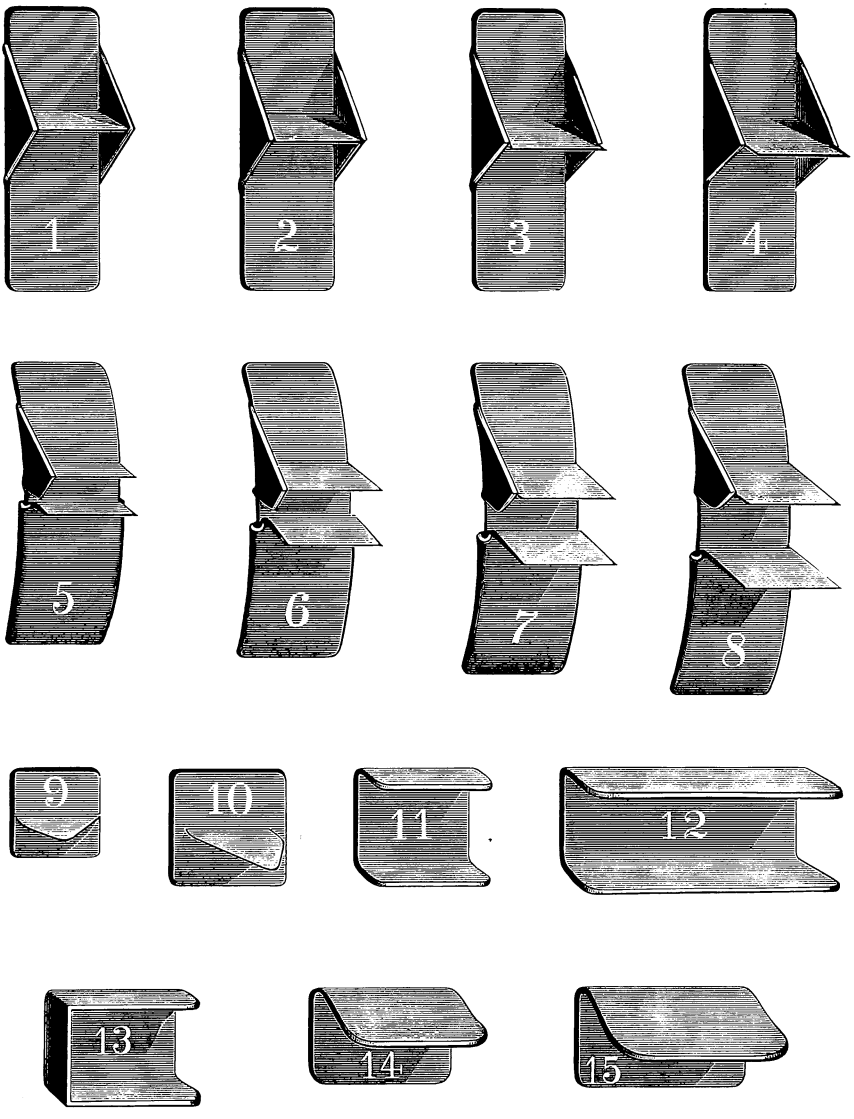


FIG. 14.

dimensions if cast onto a yielding mass. Bridges should be attached to inlays instead of crowns wherever possible, and for this purpose the use of heavy iridio-platinum posts and bars inserted into the tooth and a cast made over them, if of pure gold, makes a foundation that can be burnished to the tooth, making a better joint than a hard alloy of gold can, and with equal strength. In assembling, the section carried is soldered to the bar and surface of the inlay. Because of the impossibility to entirely control the contraction of the gold it is best to cast the foundations and section to be carried separately, and then assemble.

When casting over porcelain bridge teeth, if you will place a piece of iridio-platinum bar tightly between the pins before casting, it will be almost impossible to break the porcelain, provided it is well heated and the porcelain surface is flat and not convex. In orthodontia the stone is used to cast appliances upon. The waxing is done with a small paint brush and the wax is heated hot in a dish and painted to place with great simplicity and ease. In taking the impression it is very desirable to have appliances a trifle larger than the tooth. This is accomplished by placing over the impression, after it has been removed and partially cooled, a piece of rubberdam and then replaced over the teeth and pressed tightly to the teeth. This enlarges every surface the thickness of the rubber.

There are many other uses for the stone, such as making occluding models for setting up teeth, in which case the cusps of the teeth are so strong as to allow of pressing the porcelain into position which can not be done with plaster-occluding models. It is also very useful for record models where its hardness is a great advantage. Fig. 14 shows the trays used for taking impressions of cavities; numbers 1-4, inclusive, are for taking proximal cavities, and differ only in the length of the septums, viz., from 3-16 to 4-16, 5-16 and 7-16; 5 to 8, inclusive, are for taking compound approximal cavities and crown bases, and differ also only in the length of the septums. They are adjustable. Numbers 9 and 10 are for the two-section impressions of the anterior teeth; 11, the short box for occlusal involving buccal or palatal or simple occlusal; 12, a long box for several teeth together, not involving undercuts; 13, the disto-occlusal cavities of the third molars and similar cavities; 14 and 15 the anterior teeth from the incisal edge.

The trays go by the numbers here given and must be made of very strong material, otherwise they will spring and distort the impression, making failure certain.

Some Thoughts on Casting.

By Dr. A. M. Johnston, New York.

Read before the Central Dental Association of Northern New Jersey.

There is an old, sound, and well-proved axiom, that the vocal cords of a singer are not as responsive on a full stomach as on an empty one. After partaking of this bountiful repast, it is the writer's hope that he may make himself clearly and interestingly understood in the cadence of speech. Perhaps some of the notes of the scale may jar upon your sensitive ears; perhaps some of the measures may sound like chords of Chinese music; if so, gentlemen, I trust that you will remember that we each have our viewpoint, that the individuality of the composer controls the dominant theme, and that with a little effort on your part it can be transposed to other keys and placed within the working compass of the individual.

When your very energetic friend and worker, Dr. Waldron, requested a paper for the May meeting, the writer saw visions of exploiting some of the many topics that are now vibrating the Dental harp, but upon a second interview the preferred theme was found to be one running in the casting chord. As I can not entirely disregard one's wishes or suggestions, we will first consider the ways and means for making the most ductile and malleable of metals assume in the fluid state, under pressure, those shapes and forms best suited for our professional requirements. The writer's first intentions were to treat this subject from a chemical and theoretical standpoint, but second thought leads him to believe that the practical or technical side would be of greater interest.

There are many articles at present being read and published on many subjects, but they are few and far between, when after reading or listening you feel that you can go home, take hold and accomplish some desired results. Working-plans are what we require, gentlemen, not merely a rough outline. We have articles on "The Cure" of pyorrhea, but how often, after listening, can every one go and do likewise? Of the pain and discomfiture to the patient nothing is said; all the glories are shown, but none of the difficulties. Essays are written on the value of foil and cast fillings, but I have yet to see the lines where the statement is made that not more than half the operators know or have that peculiar sense that is necessary for the perfect manipulation of foil. A gold filling that has not a high specific gravity is of very little use, to say nothing of those

that show disintegration by pitting, or can be removed, piece by piece, with a hand instrument.

Casting Gold.

As regards the process of casting, the first requirement is the right kind of machine. One that is mechanically accurate, convenient, and which embodies a perfect flexibility of control, so that when you wish to produce certain conditions for a given class of work with different metals you have not to make a long guess, but can either create or reproduce the form as you may desire. Then, gentlemen, you want a machine where at some critical point, say the melting of the metal and applying of pressure, only the minute portion of a fraction of a second is lost.

Investments.

The investing compound also stands on par with the machine in importance, and it is advisable to use only the best. That which seems to give the writer the most satisfactory result is manufactured by the Consolidated Dental Mfg. Co. In its mixing a great deal of care and judgment must be exercised. It is advisable to mix by weight two parts of compound with one part of water; place in a rubber bowl and blend thoroughly. Its consistency should be smooth and creamy. Great care should be exercised that all air bubbles be worked out. This can be accomplished by tilting the bowl and rotating the mix in a thin layer around the sides. Personally, I find that a jarring of the bowl produces, after a thorough whipping up, the desired results. All gases from the chemical union of the silica, plaster of Paris, and water must be eliminated. After many experiments, both simple and compound, the writer is lead to the conclusion that pouring the mold is the easiest and about the most satisfactory; care must be exercised in the operation, and some compound must first be placed on the inner side of the wax restoration and well flowed over its surface; then from one side of the casting-ring the entire mold can be run.

Wax for Inlay Models.

The inlay wax should be pure, not sticky; hard, and of a smooth, even grain. A wax that, when subjected to the burning-point, will leave no coarse carbon deposits. Its melting-point should be low. thus avoiding contraction as much as possible, but of sufficient degree to resist the heat of the oral cavity, thus preventing a dragging of its surface under manipulation. Here I am undecided whether to prescribe the wax or let you choose your own. So far the writer has only found two on the market that apparently meet the requirements. The first was that distributed by Dr. Taggart; the second is manufactured by the Consolidated Company. Great care should be exercised in its manipulation. Too great a heat forces the molecules apart, and in re-arranging on cooling, a con-

siderable contraction is the result. The wax should not be subjected directly to the flame; it is preferable to use an aqueous bath, not too hot, for the less heat, the less contraction. This reference is made more especially to prosthetic operations, although in many cases the writer uses it in the fluid state in operating in the oral cavity. For your inspection, gentlemen, I herewith submit two samples of an inexpensive melting contrivance. The materials for same were purchased at an ordinary hardware store. The small one is a tin cup, having attached thereto a cover with a hole for receiving porcelain wax retainer, and holder for keeping brush immersed. The larger one is made of two pans, soldered rim to rim. The bottom of one is so arranged as to conveniently carry three porcelain cups, the uses of which I will speak of later.

Pressure Required.

We will now take up and consider for a few moments the pressure that seems best suited for the molten gold. There is, at the present time, a system of tables being formulated in the laboratory, of which I do not feel at liberty to make any definite statement, but in a general way I may remark that it varies with the size of cast and the stiffness of material; also if the mold is free, or if it contains iridio-platinum strengtheners. The number of leads also exert their corresponding influence.

We have so far considered the machine, the investment, the wax, and the pressure. Next in order comes the destruction of the wax model. The writer feels that few fully realize the importance of the destruction of the wax core in relation to the finished product. The heat applied should be just sufficient to destroy the composition of the model. Having the ring with its investment ready, the crucible cap or former removed, hold the brass sprue over a small alcohol flame and heat so as to loosen its grooved end from the wax model, exercising care not to force or mar the mold. Over a good, strong Bunsen burner place four thicknesses of three-eighths of an inch sheet asbestos, at the same time placing thereon the invested mold. Allow it to remain until the moisture is eliminated. Then gradually, at stated intervals, remove a section of asbestos until the ring is brought in contact with the flame. Then over this place an asbestos cone having a slight opening at top, and burn until, when looking through the opening, the bottom of the mold, as seen through the sprue-lead, shows a very dull red. Thus you have a guide to indicate that the piece is ready for the machine. Personal preference leads me, gentlemen, to the use of an electric furnace, for there the heat is received equally on all sides, and whatever expansion or contraction take place in the ring's contents is universal, while, from the one end application of the flame the lower part first expands or contracts, followed by lessened ratio toward the top or that point which does not come directly in contact with the

flame. In the combination of silica, plaster of Paris and water, we have substances that are not fool-proof, and care and judgment must be exercised in the use of same.

Gold and Platinum Recommended.

Now, as it is not possible to complete our operation without the metal, and as our time and patience are more or less limited, we will refer only to gold or the seven per cent. gold and platinum. The latter is a combination that lends itself beautifully to many conditions; but one of the chief points is that it must be brought to an absolutely fluid state. And, as a side remark, I would say that it is well when operating a Taggart machine to use a pair of number four burnt glasses, thus modifying the excessive strain of the incandescent light rays on the retina. The pressure used is about nine pounds for general work, and from personal experiments the indications point to no apparent reason of calling into use more preasure than is just sufficient for carrying the gold to all parts of the mold.

Preparation of Cavity for Inlays.

We have now covered those steps that are generally performed in the absence of the patient, but the time has come for us to return to the chair. It is here the writer feels that many of the mistakes that are laid to the machine are perpetrated. In the matter of cavity preparation, it is well that the walls have a slight divergence to the line of removal. That the edges of the cavity be stoned and polished, and that the enamel edges be slightly beveled, thus leaving a fine feather edge on the inlay that can be burnished or spun out, either before or after setting. The preparation of an inlay cavity requires even more care and time than is usually bestowed on one for foil, but the beautiful results in articulation fully repay both operator and patient.

Making the Wax Inlays.

It is not possible in the time at our disposal to consider all the varieties, simple, compound and complex, that arise in the dental organs, but, for illustrative purposes, we will consider a posterior approximal and morsal surface cavity in a lower first molar. After slightly separating, so as to allow for the matrix, the cavity being prepared as previously mentioned, with the addition of two guides, a matrix is adjusted and the softened casting wax is firmly forced into place; then the articulating surface is softened with a warm spatula, or hot air, and the patient made to close and move the jaw as in masticating. All surplus wax is then cut away, the matrix removed, and suitable instruments are employed for trimming and finishing the edges and contour, after which a thin strip of tape or celluloid, such as is used for artificial enamel, is then moistened

with glycerine and drawn over the cervical and approximal edges. From time to time the patient is permitted to use cool water, thus keeping the wax in right condition. With powerful magnifying mirrors the edges are looked over carefully, and if everything is in perfect shape the sprue is warmed and attached to the most prominent and convenient point. If the cavity has been properly prepared, no stress is necessary for the removal of the wax restoration. The writer finds it an excellent procedure, before making the inlay, to moisten the cavity with glycerine and force some very hard wax into place, testing whether there is any resistance or drag to its removal.

Prosthetic Uses of Casting Method.

We have so far considered the proocess in its relation to the broken-down portion of a dental organ. Permit me for a few moments to speak of the importance or value of the casting process to the prosthetic side of dentistry. Generally speaking, it is applicable to all kinds of work, even to the making of regular appliances, and for those operators who prefer to retain their cases by the method of clasping, lingual and palatal bars, bridges and foundations for bridges, all come under its broad and general scope, making it quite difficult to know and choose of which to speak. Perhaps it is just as well not to mention any specific work, but confine ourselves to the model and its preparation.

There is an old and well-established law, that in order to have success with an artificial appliance, the professional worker must be supplied with an accurate cast. On the supposition that we have this requisite, we will consider only two phases—painting the model and casting on platinum. In the first process, the work is laid out with an ordinary graphite pencil, and that portion of the model not required or entering into the finished denture is painted with a coating of ordinary wax. The cast is then immersed, or painted with glycerine, until sufficient absorption takes place. It is then lightly wiped with dry cotton, and the regular inlay wax is then painted on with a fine camel's-hair brush. Observe that the two waxes are united, thus overcoming warping or contraction, when hardening, of the inlay wax. The number of layers or brush strokes determine the thickness of the cast. The sprue formers are then attached, the number to be reckoned by the size of the case and its thickness. It is necessary to reinforce the wax with investment compound, and then freeing the edges with a sharp instrument, remove, invest in ring, burn out wax and cast.

In the lining of a case, or when casting to platinum, it is necessary to burnish on the model where wanted some one two-thousandth of an inch porcelain inlay matrix platinum, being careful to use the strips a

little wider than the finished case demands; then follow out the foregoing instructions.

In closing, gentlemen, I would say that the field of the casting machine is large and its possibilities great. It is a subject that one might write about until the freezing of the Panama Canal, for with the blending of gold and platinum, and the use of our low-fusing porcelains, combinations can be made that are most artistic. There is one point that the operator must keep in mind. Gold and its combinations become stiff or sluggish after repeated heatings, due to the ferric oxid that is present to a greater or less degree in the investment compound. With a few minutes' use of an ordinary gas blow-pipe, a charcoal crucible, some borax and potassium nitrate, this can be eliminated.

For those who feel that the shrinkage of gold is a great detriment to the inlay, the writer would quote from an article by M. L. Ward. After careful experiments and measurements it was found that the casting for a compound approximal cavity in a molar measuring one-half inch showed on calculation a total shortening, mesio-distally, of sixteen ten-thousandths of an inch. These calculations were made for casts of gold heated above its melting-point and a little below its boiling-point, and cast into a cool mold.

There is a specific point that the writer trusts each and every one will lay to heart.

Too much haste makes wilful waste. Each step in the casting process is interdependent. At each turn care and watchfulness must be maintained. Everything has its speed and speed limitations. The locomotive of a certain weight and power can be driven and hold its traction so many feet per minute. Try to force the mechanism beyond that point, and the result is a tremendous loss of power, due to slipping, with a corresponding increase of wear.

Discussion of Dr. Johnston's Paper.

Dr. H. E. S. Chayes, New York.

Mr. President and Gentlemen: It is somewhat difficult to discuss Dr. Johnson's paper, because he generalizes so broadly, and that about a subject so important that we are hungry for every specific statement which can be made about it.

The casting process, as it seems to be universally called, will solve a great many problems for the hard, conscientious worker in the dental

profession, and I make so bold as to state that the deeper the dental profession goes into this Taggart proposition, the greater grows the debt of gratitude we owe to this man from the West.

The possibilities of this process may be better surmised than definitely stated; it will take years to find its limitations and work out all the problems it conjures up.

If one may venture any specific statement at all, I should like to say that the direct pressure machine has the field all to itself. The other means in use, centrifugal and suction, respectively, are inadequate for absolute or nearly absolute results.

Another statement which may be regarded as permissably specific is that graphite must become a factor in successful investing compounds; to what extent we do not yet know.

The gradual heating up of the mold and burning out of the wax is a most important step in the chain of events which may lead to a successful accomplishment of the task at hand. When the wax model is a large one, and hence by virtue of its permeating the body of the mold would threaten to impair the integrity of the investing compound, it is best to remove the wax by inserting a hollow copper tube into the sprue-hole and applying the siphon principle. A Roach carver, the point of which has been lengthened, will cover the need very successfully.

I use the Platschick thinnest base-plate wax for saddle work, and the Consolidated wax for inlay purposes. It is absolutely not advisable to paint your wax on the model with a brush, because of shrinkage that takes place in cooling and the consequent disorganization in the assemblying of the various pieces.

A seven per cent. alloy of pure gold and platinum is too hard for inlays unless they are in occlusion with artificial teeth of a bridge. For occlusion with natural teeth a three-fourths, or at the most five per cent. alloy of platinum, is ample for hardness and resistance to spreading under stress of mastication.

If the inlays are to be used to carry dummies in the construction of a piece of bridgework a fifteen per cent. alloy of gold and platinum will serve the purpose much better than seven per cent.

The amount of heat to subject the flask and mold to would vary materially with the task in hand, the first cardinal principle being that every vestige of wax must be burned out. If the mold contain any pins of iridio-platinum, or if it contained any hood of platinum it must be heated to an extent which will put the therein-contained metal into the most receptive condition (molecularly speaking) for its union with the gold to be forced into the mold.

The practice of attempting to cast large and irregular saddles at right angles to the sprue is not good physics. One can see that any attempt to cast such saddles at right angles to the sprue must involve the problem of forcing the molten gold into the 360 radii of a circle, and that the success of this would be in an inverse ration to the (1) amount of platinum contained in the alloy; (2) to the size of the saddle; (3) to the thinness of the saddle; (4) to the length and directness, tortion or undulation of the radii. On the other hand, the success of these large thin saddles can be more often assured by casting in direct line with the sprue-hole and not at right angles to it.

In using the cast inlay for retention of dummies in bridgework great care should be exercised in the preparation of the cavity and an acute angle of at least thirty degrees must be formed by the occlusal and approximal walls of the cavity. Failure to observe this point will invariably involve failure of the work.

The shrinkage of the molten mass upon cooling is a difficult problem to solve and will, I think, finally be eliminated by an expanding compound (not an expanding wax as someone has suggested). This much, however, is to be observed, the greater the mass the greater the shrinkage, and a partial solution may be obtained by casting in sections and joining these, in the case of dummies for bridgework. And the shrinkage of saddles may be controlled more or less by having the wax exceedingly thin, the mold exceedingly hot and casting quickly and with as much pressure as the investing compound will withstand.

Let me finally say that anyone who takes up casting, determined to exercise the utmost care and vigilance at every step of the work, doing everything, taking nothing for granted, following tenaciously and religiously every point which seems to lead to the final, the great light, the acme of artistic perfection, can not help but realize great benefits from the process given us by the Western wizard.

Dr. Homberger. I have obtained very good results during the last year in casting with the hand-driven, centrifugal machine, which apparently has been a success. The method of investing is as follows:

It is usual in the investing material to paint over the wax matrix very evenly and as soon as that has practically hardened we use equal parts of plaster and sand; and this plaster and sand is put into a rubber ring and then the entire investment with the sprue is placed down into the wheel and is allowed to get hard, and the rubber ring is taken off. You do not get the expansion which you do with some other methods. When I was using metal rings and using it the other way, I got more expansion and contraction than I do now.

Dr. Carr. I have not found any investment so far which is perfectly satisfactory, but I think that in time we will be obliged to have at least two or three different investments with different properties for different kinds of work.

Dr. Johnston. There is a story to which I might refer, and which, perhaps, might touch the point. It was told on an old deacon, a pillar of the church, who was long-winded both in prayer and in speaking. At a meeting which was held, a rule was adopted to limit the speakers to five minutes, and a half dozen speakers had expressed their views and stopped promptly when the time was up. Then the deacon arose, and when his time was up he had only half finished when he was told his five minutes had expired. "Then, brethren," said the deacon, "I will utter the rest of my remarks into the form of a prayer."

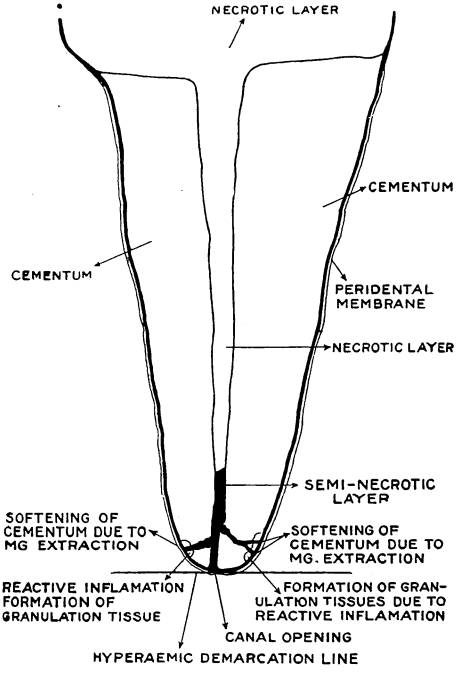
The Chemical Pathological Changes Occurring in the Pulp, During the Stages of Infection and Decomposition.

By J. A. Vuilleumier, D.D.S.

Read before the Massachusetts State Dental Society, June, 1910.

Infection. Most inflammatory conditions of the pulp are due to bacterial infection. As soon as the micro-organisms have reached the pulp there is a marked vascular dilatation in that area. A great many leucocytes migrate into the pulp tissue proper, and by secreting alexines (complex proteid corpuscles stored within their bodies) or by phagocytosis, they attempt to destroy or inhibit the invading bacteria. On the other side, bacteria produce toxins, which are albuminous bodies. Foremost among the invading pyogenic micro-organisms are the streptococci. Miller, Baumgartner, Mayrhofer, and Sieberth found them predominating. Besides streptococci we find staphylococci, sarcinae and yeast cells, according to the stages of infection and the conditions present. If the inflammation and infection proceeds, the capillaries and small veins become very much dilated, as in all inflammations. The connective-tissue cells atrophy—odontoblasts disappear. There is an extravasation of blood into the surrounding tissue. Stasis is followed by thrombosis and the circulation stops. Immediately there is an entire change of the bacterial flora. We have now an anaerobic medium, as the O_2 [oxygen] has been shut off by the arrested circulation. Those micro-organisms which are obligate aerobic die or are encapsulated.

Thrombosis. The conditions for clotting in the pulp are especially favorable, because the nucleo-phosphoric acid of the polynuclear leucocytes has a tendency to combine with the abundance of lime that exists in a tooth, and thus forms a soluble lime salt, the presence of which is a requisite for rapid clotting. As soon as thrombosis in the blood vessels of the pulp has been accomplished, there is an enormous chemical change taking place in the



tooth. The supply of oxygen available for chemical reactions has been cut off. The oxygen present is exhausted in forming solid chemical combinations, and a period of want of oxygen begins. This is felt especially by all the living microbes.

The Micro-organism. There are two groups of micro-organisms, the aerobic those necessitating the presence of O_2 [oxygen], and the anaerobic, which can live without O_2 [oxygen]. The division is not absolutely strict, because there are certain microbes which can thrive in the presence or absence of O_2 [oxygen], and which are called facultative aerobic or anaerobic bacteria. Most microbes can endure the adverse conditions

without succumbing, though turning into a condition of utter chemical inactivity. The pus microbes, such as the streptococci and staphylococci, seem to disappear. Some, however, are encapsulated in the ramifications of the dentinal tubuli and canaliculi of the cementum, thereby escaping the overcrowding by the anaerobic flora.

Among the anaerobic bacteria we find streptococci (of which some types are semi-anaerobic), bacilli, etc. Among aerobic bacteria: Streptococci, staphylococcus, pyogenes aureaus, citreus and albus, other micrococci and bacilli, etc.

The Catabolism of Albumen.

The chemical interchanges that take place now are almost unique in the body, *i. e.*, the albumen goes through a process of absolute anaerobic decomposition. We cannot go into all the details of thrombosis and coagulation necrosis. It may be sufficient to mention the following:

For want of O_2 [oxygen] all the cells composing blood vessels, nerves and connective tissue of the pulp become necrosed, of course, partly through the influence of the toxins from the pus microbes and of those formed by the anaerobic group. The membranes of the dead cells change their osmotic qualities. There is a general interchange of the many albuminous substances that form these different cell bodies and cell nuclei. This mass of albumen composing the pulp, with all its complicated molecules and nuclein, etc., splitting up, begins to peptonize (through enzymic and bacterial action). The large molecules of proteins, albuminates, albuminose and peptones begin to split up into amino acids, glykocoll, amino-propionic acid, leucin, cystin, indol, skatol and lysin. Dr. Buckley and various other authors have already mentioned some of these facts. Some of these substances are combined with phosphoric combinations or with fatty acids and split up again into smaller molecules. There is a possibility that some of the members of the purin group, which are the relatives of uric acid, are formed. The phosphorus atoms are combined with the oxygen atom to phosphoric acid, the sulphur atom tries for the hydrogen atom, the chlorine atom goes to the hydrogen atom, and the nitrogen and phosphorus atoms that do not obtain oxygen go to hydrogen atoms and form NH_3 [ammonia], or PH_3 [phosphoretted hydrogen].

The Ultimate Products.

Of course these acids with their strong affinities combine at once in the nascent state, with their affinities amongst the metals. The phosphoric acids combine with the calcium of the dentin to an insoluble molecule. The traces of sulphuric acid also attack the calcium forming an insoluble molecule $CASO_4$ [calcium sulphate]. The chlorine has a

special affinity for Mg. [magnesium] which forms part of the dentin and cementum. Fluor is freed by H_2SO_4 [sulphuric acid]; and the H_2SO_4 [sulphuric acid] enters into a reciprocal action with Ca. [calcium] and Mg. [magnesium]. The most important acid is the HNO_3 [nitric acid], which combines with Na. [sodium] and K. [potassium].

It is very unlikely that we find any gases free because in the nascent state they combine the hypotheses which Dr. Buckley has brought before us, regarding the reactions taking place between NH_3 [ammonia] and H_2S [hydrogen sulphide] and HCHO [liquor formaldehyde] are very interesting. However, we know, and the doctor has mentioned in one of his papers, read before the Dental Society of the State of New York in 1905, that $2NH_3$ [ammonia] and H_2S [hydrogen sulphide] will combine forming sulphide of ammonia. Now sulphide of ammonia $(NH_4)_2S$ when acted upon by HCHO [liquor formaldehyde or formalin] will form an entirely different reaction than when in contact with each constituent molecule separately. Richter in his "Organic Chemistry" states besides, that hydrogen sulphid has a reducing action on the formaldehyde; the sulphur replacing the O_2 [oxygen] atom of the HCHO [liquor formaldehyde], forming HCHS [thioformaldehyde, plus H_2O [water]. This HCHS [thioformaldehyde] is a very unstable molecule which polymerises itself almost immediately into $C_3H_6S_3$ a substance which has no antiseptic properties. A similar reaction would take place if we had $(NH_4)_2S$ [ammonium sulphide]. In this case free NH_3 [ammonia] would be liberated and it is possible that if a large quantity of NH_3 [ammonia] is present, it will combine with HCHO [liquor formaldehyde], forming a substance known as hexamethylentetramin or urotropin. To ascertain more correctly what the results are if liquor formaldehyde and hydrogen sulphide are brought together, I have brought with me a solution of formalin, or liquor formaldehyde, and a saturated solution of hydrogen sulphide. We shall now saturate the solution of formalin with hydrogen sulphide. *If free sulphur and methyl alcohol are present, the sulphur will be seen suspended in the solution. There is no indication of any such reaction taking place. The solution remains clear.*

Effects of Formocresol on Putresant Pulps.

In my opinion the action of the formocresol mixture on the decomposed pulp is mostly bactericidal. The rapid relief which we obtain when opening such a tooth seems to me to be brought about by the following:

First. We reduce the pressure under which the fluids in the decomposed pulp are held.

Second. If gases escape, they have been dissolved in the pulp under pressure and are freed when the pressure is relieved. If any gases are

present they will escape. Example: (syphon). Here we have carbonic acid gas held under pressure in water, when the syphon is charged there is no indication of gas present. As soon as we relieve the pressure, we see the gas bubbles escaping from the water.

Third. By sealing in a 20 per cent. solution of formocresol we check the action of the bacteria almost immediately.

We know that formalin is one of the strongest disinfectants we have, and when in contact with the semi-fluid contents of the pulp chamber it will inhibit the development of the bacteria present, until such time when it has united with the substances of decomposition in the pulp, and has formed different compounds, losing its antiseptic properties.

I think this explains to us why we get all the recurrence of the symptoms of a dead pulp if we seal into the pulp chamber the formocresol combination and leave it in, a few days. The first 24 hours the tooth seems to regain its normal condition. As time goes on, however, and we leave the same treatment sealed in the tooth, inflammatory symptoms reappear. This can only be explained by the fact that the germs in the smallest canaliculi are not reached by any disinfectant and remain there until there is a chance for them to grow again. That the micro-organisms grow into the dentinal tubuli and canaliculi of the cementum has been shown by Miller and various other authors. Of recent date Romer of Strasbourg has given us a series of micro-photographs, in which you can distinctly see the streptococci, in chainlike form, in the dental tubuli.

The Importance of the Nitrites.

The microbes, even the anaerobic, have an intense hunger for O_2 [oxygen] and are capable of tearing away one oxygen atom from the nitrates, *i. e., they reduce the nitrates to nitrites. The nitrous acid* (HNO_2) *has quite a special affinity for the Mg.* [*magnesium*] *and Ca.* [*calcium*[*and leaves the Na.* [*Sodium*] *and K.* [*potassium*] *combinations for the Mg.* [*magnesium*]. *Thus there must be a Mg.* [*magnesium*] *extraction from the cementum, leading to a gradual widening of the canal and the canaliculi wherever the nitrous acid molecules can reach the cementum.* Of course it is augmented by the decomposition of chlorine, as mentioned above. The cementum would soften at that particular place. There are a number of chemical details that could be added here . It may be sufficient to say that through the bacterial decomposition some albuminous bodies can be transformed so far as to form humine substances, humus acid, whereby the black color of such pulp might be explained. Part of the black coloring, especially in the early stages, is due to the Fe. [iron] combinations that are derived from the decomposition of the haemoglobin, haemin and iron sulphur combinations.

The Formation of an Alveolar Abscess.

These chemical processes, which tend to soften the dentine and cementum, have naturally a tendency to widen the root canal, the dentinal tubuli and canaliculi of the cementum. Where the latter are the shortest, near the apex, there is, of course, a relatively short time for the process to reach the pericementum. The standstill of the necrosis is at the apex, right at the canal opening. There we have all the stages, from an anaerobic decomposition of albumen in the canal to a partly anaerobic coagulation necrosis, to a semi-necrotic layer, in which probably some aerobic microbes still live, to a hyperaemic demarcation line in which the antitoxins hold in check the few streptococci and other pus microbes that have escaped the action of the anaerobic bacteria. As soon as the softening of the cementum begins to irritate the periosteal cells of the pericementum, there is, of course, a reactive inflammation taking place in that spot. Gradually the osteoplastic cells grow into the softened cementum and form a kind of granulation tissue, with abundant blood supply. Now there is a chance again for O_2 [oxygen] being absorbed. There will be great chemical changes. Instead of reduction we have oxydation, and what is most important, an aerobic flora will spring up instead of an anaerobic! Now much will depend on whether the pus microbes have survived or not. If they have, there will be an alveolar abscess formed. If there is no abscess, calcium material may be deposited and again the O_2 [oxygen] supply is shut off. Again the anaerobic process would start up until a new perforation is formed and bring it to a stop, and so on.

The whole process can only be seen in such canals in which the pulp chamber is hermetically sealed, so that the saliva is prevented from washing away the products in the pulp chamber and in the roots.

In pulp chambers which are open, the process also goes on. Here, however, the products of decomposition are constantly diluted and washed off, so that there is less likelihood of severe softening of the cementum. *This would explain to us the formation of an alveolar abscess in teeth in which the pulp has died gradually without giving the patient severe discomfort.*

To investigate the presence of nitrites I have collected a number of teeth in which the pulp was decomposing and which showed all the symptoms of the formation of an alveolar abscess. To prevent further chemical changes, I placed them in paraffin oil until I had some material on hand. The teeth were then split open and the contents of the canal removed with a broach. They were placed on a slab, mixed with a little distilled water, and a few drops of diluted H_2SO_4 [sulphuric acid]. To this was added a solution of metaphenylendiaminchlorate. If nitrites

were present the reaction would be brown, known as Bismark brown. Twice we obtained a slight reaction.

I have not finished studying this question, but as the time seemed to be opportune, and as your Society has given me permission, I have brought this introduction to the work before you. The contents of the root canal in such teeth are so small that it is difficult to get distinct reaction. The whole mass may be about one micromilligram, or less. If there is 1.1000 nitrite in a milligram, it means 1.100,000, or 0.000001, or 1/60,000 grain—about the lowest quantity for any chemical reaction.

In conclusion, I wish to say that I am much indebted to my friend, Dr. Fritz Schwyzer, for his valuable information on the decomposition of albumen.

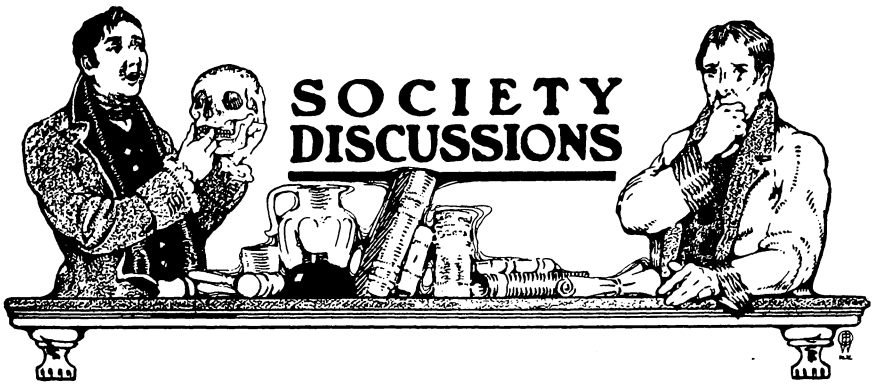
Tetanus.

Before closing, however, I want to mention a very interesting case of tetanus infection which occurred at the Harlem Hospital, New York City. The patient, a girl ten years old, presented herself with slight swelling of neck of four-days' duration. She was able to talk and eat. The next morning she could open her mouth but very little, and by evening the trismus was pronounced. She complained of headache and soreness of the teeth. Her buccal secretions constantly dribbled from the mouth. Later in the same day she vomited clear fluid. She was unable to take solid food. Eight days later she was taken to the operating-room and two bicuspids and a cuspid were extracted. An attempt was made to give her a general anesthetic, but the patient immediately had a seizure of convulsions, which was overcome by amyl-nitrite. The symptoms being clearly those of tetanus infection, and the patient growing worse hour by hour, a spinal puncture was resorted to and a 18 c. c. of tetanus antitoxin injected. The patient had severe clonic contractions the day following, and died in another seizure the same evening. A diagnosis had been made from the clinical picture as tetanus infection. There was no other visible wound on the body save a few carious teeth in the mouth. They were removed and submitted for examination.

The bacteriological report showed streptococci, staphylococci, bacilli, spirilla, and diplococci.

By culture the tetanus bacillus was produced.

The patient had the habit of picking her teeth with anything that came to hand—a straw, a needle, or a pin. We know that the tetanus bacillus is found in garden earth, and radishes which are not properly cleaned could offer means for carrying the infection into the system by way of a carious tooth.



Second District Dental Society.

January Meeting.

The forty-first anniversary meeting of the Second District Dental Society of the State of New York, was held on Monday evening, January 10, 1910, at the Kings County Medical Society Library Building, No. 1313 Bedford Avenue, Brooklyn, N. Y.

The president, Dr. F. T. Van Woert occupied the chair and called the meeting to order.

A large audience was present, members of the First District Dental Society, the New York Odontological Society, the New York Institute of Stomatology, and the Central Dental Association of Northern New Jersey, having been invited to attend this meeting.

A clinic was given in the forenoon and afternoon by Dr. Weston A. Price, of Cleveland, Ohio, who was the essayist at this meeting, demonstrating the technique of his method.

President Van Woert. If there are no objections, we will suspend the regular order of business and proceed to the paper of the evening.

It affords me great pleasure to present to you Dr. Weston A. Price, of Cleveland, Ohio, who will read a paper, entitled "Casting to Models, with Its Advantages and Technique." (Dr. Price then read his paper, published in this number.)

Discussion on Dr. Price's Paper.

President Van Woert. Dr. Price has finished his lecture. While it was announced to me this afternoon that the gentleman whom I desire to call upon, does not wish to speak this evening, due to physical disability, I think every member present will feel as I do, that there is no one better qualified, and no one we

would be more glad to hear from, than our esteemed friend, Dr. J. Leon Williams, of London, England.

Dr. J. Leon Williams, of London, England.

Mr. President and Gentlemen: I have but very few words to say on this paper, and those few words are entirely commendatory in character. I think one of the greatest pleasures in life—certainly in our professional life—is to meet a man who is master of the situation. I do not know of any greater pleasure in life than that. It implies everything that is involved in what we call evolution—the conquest of mind over matter—it is all figured in the mind of the man who is master of the situation.

I attended the clinic this afternoon and watched Dr. Price. I heard a great many questions asked—some of them very sharp and clever—that involved the consideration of principles a good deal outside of the practical line of work that he was demonstrating, all of a scientific nature, and it delighted me to see how thorough his investigation had been outside of the practical part of the work; how it rested on the most thorough and complete scientific investigation into all the side issues involved, and every answer to those questions demonstrated that he was master of the situation. I have made a great many experiments in inlay work. I am the fortunate, or unfortunate, possessor of three casting machines. I have not the Taggart, because I could not get it. I tried for a long time to get it, and I saw others were going on with inlay work, and I was falling behind, and I bought the first inlay machine I could get. However, the results were not satisfactory. Then I bought another, and another. My chief difficulties arose largely in deep approximal cavities, where they extended below the gingival margin. I was not able to control the shrinkage so as to get a joint at all satisfactory to me.

Another difficulty was the one to which the doctor referred—of getting the inlay placed after it was finished; but the one that chagrined me most was the lack of a good margin at the cervical border. By accident one day my wax model had a flange, and I saw that that covered the joint, and I said, "Why not do it in that way?" Since then I have made a point of doing it, and from that adopted the method mentioned by Dr. Price to the extent of using beveled margins. While Dr. Van Woert says he gets perfect contact there with a butt joint, I can not do it, and I am going soon to spend the day with Dr. Van Woert, and I hope to get some good points from him.

By having the flange slightly overlapping the bulk of the cavity, I have been able to get better results. I said to Dr. Price—and this will illustrate my appreciation of this lecture and of what I saw this afternoon—that I was not altogether satisfied with what I saw to-day, and I

did not think I should be satisfied unless I could make an arrangement to go to Cleveland and spend several days with him; and he has very kindly given me an invitation to do that. I can express my confidence that this is an advance on anything I have ever seen before—a most complete and scientific method for gold inlay work.

President Van Woert, We have one of our own members with us whose name is well known to you in connection with this work, and you will all be glad to hear what Dr. Ottolengui has to say.

Dr. Ottolengui. You all know I have been a lifelong friend of Dr. Van Woert, and of Dr. Rhein, and neither one has been able to convince me that there is any advantage in the model method of making gold inlays. Dr. Price comes nearer to convincing me of it than anybody, and that brings me to the crux of this whole situation. I am not attracted by the advantage of having a tooth in my hand to fill it, because I have been filling teeth in the mouth for a good many years, and I can manage them in the mouth. I can do exactly what Dr. Price says I can not do. I can make a wax inlay for a cavity and remove it with less distortion than I have been able to remove any impression of that cavity which is used afterward for making a model of that cavity. Those facts are the same in connection with this method as any other; but the attractive feature in this method is not in the fact that this stone model may be used to form a wax model of an inlay, but that it may be used to cast the inlay into. I do not think anyone has spent as much time studying the contraction of the materials to be used in this way as Dr. Price has, and he admits the impossibility of absolutely controlling these contractions; but, as he truly says, what does it matter, so long as you can preserve the cavity surface of your inlay, and make it accurate? If you can change the location of the shrinkage of the gold, so that it will affect the surface that you are going to alter anyway with your polishing process, it is a matter of no consequence, because the 1-1000 which represents the shrinkage is of no moment, if it can be made to occupy some other portion of the inlay, rather than that portion which goes into contact with the cavity. That, of course, is exclusive of margins. If you have contraction enough to make it impossible to have perfect margins, that ruins the inlay. I remember when Dr. Taggart gave his demonstration in Jamestown, a gentleman arose and said ,"The day of art in dentistry is about to vanish; fillings are now to be made by machine." It seems to me the day of artistic dentistry has just dawned.

President Van Woert. I understand that at a recent meeting of the New York Institute of Stomatology, Dr. Gillette, of New York, showed some very beautiful specimens

of cast-gold work, and read a paper upon the subject. I think he can add something to the discussion of the evening.

Dr. William Gillett, New York.

I can say but little, particularly at this late hour. I am very glad indeed to express to Dr. Price my appreciation of the immense amount of hard work he has done. Knowing a little of his capacity for hard work—reaching back to the days of cataphoresis—I can understand something of what he has been doing, and of the way he goes at his work. I have been very much interested from the beginning in Dr. Price's work. I want to say to him I am heartily in accord with him in handling inlay work by the impression or model method. I get a great deal more satisfaction myself by processes of that kind than I do by the direct method, so far as I have tried it; but I am quite ready to admit that the direct method has its advantages, and I am inclined to think many of the differences that men find between the two methods are differences of personal equation—that if the same man will make the same amount of effort and take the same pains with one as with the other, he would do as well. For instance, if Dr. Price would work as diligently on the direct method as with the impression method, he would obtain some very satisfactory results.

I want to plead for that same perfection of ideal in the inlay work that he has spoken of. It is easy enough to obtain in inlay work that same high perfection we fought so hard for in our foil fillings, and it is so much easier for the patient to have us do it in that way. For heaven's sake, gentlemen, let us do that kind of inlay work, and not "sloppy" work.

Dr. Ottolengui.

Dr. Price, can you really reproduce the cavity? Is the cavity in your model identical with the cavity in the tooth?

Dr. Price.

Very closely, but not absolutely. It is impossible to reproduce anything identically or absolutely. A standard may not mean the same thing to two men. We can reproduce a cavity within the thousandth of an inch. I would not consider the thousandth of an inch accurate. When I am working with an instrument at home that I can adjust to measure to within a hundred-thousandth of an inch, a thousandth of an inch seems large; but we can ignore a thousandth of an inch in our work if we burnish the margin as directed.

Dr. Gaylord.

In heating this compound in which the wax impression still remains you burn out the wax. Is that heat sufficient to harden your stone?

Dr. Price. Yes; but if you want to make a very hard model, heat it dull red, which I generally do. If not, there is some wax and carbon still in the mold which make it black.

Dr. J. Leon Williams. Have you experimented very much with wax?

Dr. Price. Yes, I have. This is not perfect, but it is the best I know of. I have measured its elastic and resistant qualities, and it is the strongest impression material I know of that will burn off the stone and give us a good impression and not injure the stone.

I am going to repeat a statement that I know you will not all agree with. I am sure of it, because one man told me so. To make a cavity of the best form for inlay work, into which we are going to put a cast filling, every margin should be beveled or rounded so we have a chisel-shaped edge to burnish at every point, and not a square butt joint. I fear the man is not born—unless it be your worthy president—who can make, for example, a gold filling to fit flat and flush the neck of this wide-mouthed bottle, and have it only flush with the surface, and close that joint at every point, without carrying the gold by some means as spinning to the wall, which will leave a furrow on the flat surface. He could spin pure gold there, but he would leave a little trough.

Dr. Ottolengui. Do you mean in the bottle or outside?

Dr. Price. I mean like cutting a cork off square, close to the bottle's mouth. I can not conceive how I could have misunderstood your president from the plain language he used, but I feel sure I must have misunderstood him.

President Van Woert. I am sorry, but as president of this society, I can not answer your remarks in detail.

Dr. Ottolengui. The president of our society is not supposed to take part in our proceedings. Still, as he has taught all of Brooklyn to make "butt" joints, I wish you would make him answer that point.

President Van Woert. I might say it is beyond my prerogative to answer a question of that kind, because it would take more time than I would be allowed, and that would not be fair to the guest of the evening, but when there is time, I can answer the question. [Laughter.]

Dr. Price. I can conceive of one or two points being in contact and hence a tight butt joint at those points, but to hope that all around a filling we can have absolutely perfect butt joints, contradicts the contraction of gold and

available means for correcting it, unless you have an investing material that will expand much more than any I have been able to find.

Dr. Ottolengui. You talk as though necessarily all inlays are bound to be a little too small. I have had many so large I could not use them. How does that occur?

Dr. Price. That is not an unreasonable question or strange condition. It happens in daily practice, if you use a very soft investing material. You have probably had a pressure distortion, not a uniform expansion. In certain investments you will get it apparently larger every time; if you have nearly parallel walls it will take but an extremely slight distortion of any inlay surface to prevent it seating, which is the principal cause of an open joint at the gingival margin when using a butt joint preparation at that point.

Dr. Ottolengui. It is not a question of chance, it occurs very much too often. Our president has had that experience, too, because he has invented a way of etching such inlays so that they may be reduced sufficiently to use. [Laughter.]

Dr. Price. You may have found an investing material such as I have never found, if it expands that much. I certainly want to test it, but I am almost certain your enlargement was due to distortion, a yielding of the investment.

Dr. Ottolengui. I will send it to you. It is of no use to me.

Dr. Price. The chances are you have an error there that you are not taking into account. I have tested very accurately and have not found any investing material that expands on heating even half the amount of the contraction of the gold, as you will see by the tables in Fig. 3.

Dr. Ottolengui. Can you not bake porcelain directly into the gold inlay?

Dr. Price. Yes; but there are two serious difficulties. Sometimes, owing to the contraction of gold being greater than porcelain; the contraction of the porcelain being from 8-1000 to 12-000, and the gold 20-1000, the gold will crush the porcelain. Jeweler's porcelain can be baked into gold, and the shrinkage is so great as to be near that of the gold, consequently it will not craze or check. Another difficulty is that if we have the yellow of the gold showing through the porcelain. In a bluish-white tooth, it is almost impossible to match shades. If it is a dark yellow tooth, we can bake the porcelain directly into the gold so far as the color is concerned. The low-fusing porcelains have greatest contraction and, consequently, are less liable to be checked.

Dr. Chayes. What body do you use?

Dr. Price. Jenkins', or Ash's, or Brewster's gold matrix porcelain—any low-fusing porcelain.

Dr. Ottolengui, Method for Fusing Porcelain in Gold Inlays. I want to say a word on the subject of fusing porcelain into a gold inlay. As soon as Dr. Taggart expounded this doctrine, this idea occurred to me as a possible, very attractive cosmetic opportunity, being able to get the strength of a gold inlay combined with the appearance of a porcelain inlay; but when it is attempted in practice, the difference in the expansion of the two is so different that one is liable to crack the porcelain. In the gold matrix the contraction of the gold is so weak that it is resisted by the porcelain; but where you have a large mass of gold, as in an inlay, checking is apt to occur. I had some time since an inlay which was to occupy the major part of an upper molar, the mesio-buccal angle of which would be exposed when the patient laughed, and I was anxious to have the mesio-buccal surfaces of porcelain, and the morsal surface of gold. I found difficulty in fusing porcelain into the inlay. We made several attempts, and we would find the porcelain checked. We threw the inlay into hydrofluoric acid, removed all the porcelain and started over again. Whilst there is a difference between the coefficients of contraction in gold and porcelain which enables the gold to "pinch," and thus check the porcelain, porcelain has another characteristic of which advantage may be taken; that is, elasticity. To take advantage of this, fuse the porcelain in layers, and as each is fused *cut out the current and allow the piece to cool down completely within the furnace.* This requires a long time, but when doing a beautiful piece it is well to take the time. Let the furnace get completely cold. The contraction of the gold is so slow, and the layer of the porcelain so thin, that there will be sufficient elasticity in the porcelain to yield under the stress of the contracting gold, and not check. By fusing my large porcelain-gold inlay in this way in three or four bakings we obtained an absolutely perfect piece in which I could not find any check under a magnification of about thirty powers, nor has any check developed up to this time over a year later. I have made several since then with the same result.

Dr. Price. In casting on to bridge facings your porcelains are often broken because the gold has a greater contraction on cooling than your porcelain, and, as your gold contracts over the pins, it draws them closer together and crushes the porcelain between them. If you will put between the pins a block of metal that has the same expansion and contraction as the porcelain, viz., platinum or iridio-platinum, the gold will have to stretch,

and the pins can not be drawn together, and the porcelain facing will not be broken.

Dr. Babcock. Where can we obtain this material?

Dr. Price. I hope I will not have much more trouble in trying to arrange so that you can easily get the materials, for practically no effort is being made to place it within your reach. It has cost me a great deal in both money and time, extending over several years, to experiment and perfect this material. At one time I used a physical chemist's entire time for six months to assist me. It has also been some trouble to get some one to manufacture it, for I, myself, will not enter the manufacturing business. The big manufacturers do not seem to be anxious to bother with it, not knowing whether there would be a large demand for it. If you will urge them to make it they will. I have had my brother, of the A. M. Price Electric Co., make this for us, but he is doing exclusively pyrometer work for glass and pottery factories, and has not facilities for making it. He is making a little as an accommodation. I wish the cement manufacturers would take it up, which they could most easily do, as it is directly in their line.

There are only two or three other points that I will take time to emphasize in closing the discussion. An important detail of finishing the fillings is this: After putting the filling in the tooth be sure to finish it while the cement is soft. Hold the inlay in place with a strong curved instrument and spin the margin toward the tooth by running toward the margin. The joint will be perfectly closed in that way, provided the cement is soft and very slow setting. Follow that with a fine cuttlefish disc, and then with a polished burnisher. The gingival margins will be done with hand files, gold finishers, burnishers and strips.

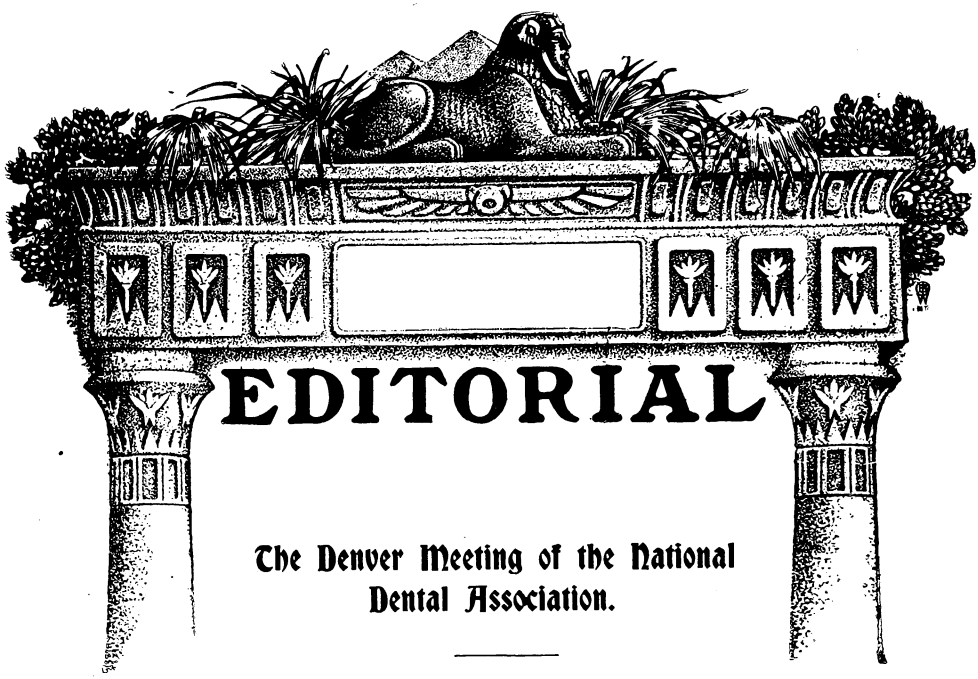
In regard to the casting machines that you may use, I have only to plead for some machine that is better than anything the public has had offered to it yet. With all due deference to Dr. Taggart's machine, and the vacuum machines, they do not provide us the range, and the flexibility, and the control we require for best results. In my office I keep trying to experiment, and I can hardly get my good assistant here to leave that electric centrifugal machine and make an inlay with anything else, even for experimentation. I believe the centrifugal principle is the best, but it must be capable of a high velocity when desired, and be able to carry large casting rings or cups. A hand machine using gears is, in my judgment, the best. With this instrument that I used to-day the gold is melted in an electric muffler and the temperature is shown by a pyrometer.

If you will ask the manufacturer for something of greater range of pressure, and yet simple and positive, I think you can get it.

I appreciate more than I can tell your kind reception and your patience. I thank you.

A very hearty vote of thanks was tendered to the essayist, which was accompanied by long applause.

Adjournment.



EDITORIAL

The Denver Meeting of the National Dental Association.

The National Dental Association invaded the West a little farther than ever before by convening at Denver, Col., and was rewarded with an unexpectedly large attendance, nearly one thousand being present. For this, too much praise can not be accorded to the local committees. Indeed, we do not recall so assidious a campaign as was conducted by the Denver men.

The scientific and clinical programs were above the average, and were carried on in an entirely satisfactory and orderly manner, there being neither hitch nor delay at any time. The meeting at which the election of new officers occurred was largely attended, and for the first time in the history of the organization a president was unanimously chosen on the first ballot, the honor going to Dr. Edward S. Gaylord, of New Haven, Conn. There was a spirited rivalry between Cleveland and Rochester, each inviting the next annual meeting. Cleveland was finally selected.

Reorganization of the National Dental Association.

The one question most frequently asked in the corridors of the hotels and in the lobbies of the convention hall was: "What is to be done about reorganization?" This problem was given much serious debate by the Council, with the result that the following resolution was eventually recommended and unanimously adopted:

Resolved, That the Committee on Revision of the Constitution and By-Laws be continued, and that Drs. R. Ottolengui and H. C. Brown be added to the Committee and that the Committee be directed to invite the President (or a representative to be appointed by him) of each of the various State Associations, the Faculties Associations, Examiners Association, the Dental Educational Council, and the Dental Faculties Association of American Universities, to a conference to be called at the pleasure of the Committee, for the purpose of considering a constitution and by-laws for this Association.

Many were greatly disappointed that a reorganization scheme of some kind could not have been adopted at Denver, but the Council undoubtedly acted with wisdom. Two propositions were before them, viz.: The recommendations of the old Committee on Revision of the Constitution, and the outline of a constitution which had been presented at the Boston meeting. In regard to the first of these, it was generally admitted to be not entirely satisfactory, and any attempt to build a new constitution upon this foundation, by submitting it for discussion by the general assembly, would undoubtedly have resulted in the construction of a constitution little if any better than the present one. In very truth, a sound constitution can best be compiled by the arduous effort of a small committee familiar with the needs of the organization for which it may be designed; a committee which will weigh every word in the hope of so framing the language that all ambiguity may be eliminated; a committee so cognizant of the wishes of the State societies throughout the country that the finally adopted constitution would be agreeable to them all, if such a result be possible. To this end Dr. H. C. Brown, last year's corresponding secretary, had solicited expressions of opinions from the various State societies, with but little success. Evidently, therefore, during the Denver meeting, the Association could not have been sufficiently informed, to act wisely upon the report of the Committee on Revision.

The plan of a constitution, which was presented at Boston, is a carefully studied scheme, modeled upon the constitution of the American Medical Association, but it is mainly the work of one man, and was never intended for final adoption without thorough study, analysis and revision by a competent committee. The vital question of annual dues, for example, was outlined in a purely tentative manner, and would be a question for much discussion; a question the solution whereof would largely depend upon how many State societies would agree to combine into a national association under the plan proposed. It surely would have been folly to adopt this constitution at Denver, and to learn thereafter that only a very few State societies would subscribe to the plan.

It is manifestly more orderly to submit a general plan to all the State societies first, and to have each State society declare definitely whether it would or would not combine with others in the formation of a large national body.

The plan proposed by the Council, therefore, is to invite a representative from each State society, either to meet with the new Committee on Revision, or at least to communicate his views to the committee at a meeting which will probably be called in Washington at the time of the meeting of the Pedagogic Society. At this time, with the views of all sections before it, a fundamental plan of reorganization could be formulated, which, in skeleton form, could be presented for adoption or rejection at each State society meeting during the coming year. Then, at Cleveland, the present Committee on Revision could report the general plan, together with the number of State societies willing to combine under it. The National Association would then be in a position to determine whether or not to reorganize on the terms suggested by the committee, and the final wording of the constitution could be completed by men experienced in constitution making.

The National Association Journal.

Many were eager to see the proposed journal of the National Association actually published. But here again the Council decided to "make haste slowly," believing that it were wiser to defer publication pending the settlement of the question of reorganization, rather than to rush into print with a few numbers and court

failure. The following report of the Committee on Journal was included in the report of the Council and accepted by the Association.

Members of The National Dental Association,

Gentlemen:—Pursuant to the vote of the National Dental Association at its last meeting held at Birmingham, Alabama, your Committee on Dental Journal decided at a meeting held in New York on December 4, 1909, to recommend that we begin the publication of a journal, in accordance with the vote of the Association, in October, 1910.

Upon further consideration and with increased knowledge of the conditions, financial and otherwise, of the National Association, and in view of the prospect of the postponement of a reorganization, we have decided that it will be unwise to commence the publication of the journal at this date.

We desire further time to secure certain desirable scientific support, and to complete other details in order to start a journal that will command the products of our best men interested in research and other scientific work. To that end we respectfully request that the matter of the establishment of the journal be deferred until next year, and that the Committee on Journal be continued with the same powers as previously.

We further recommend that a fund be created, called the Journal Fund; and that one dollar ($1.00) annually, from each member's dues, be set aside for this purpose.

Respectfully submitted,
(Signed) D. O. M. La Cron,
I. D. Patterson,
Charles S. Butler,
Wm. B. Diming,
Herbert L. Wheeler, Chairman,
Committee on Journal.

National Board of Public Health Advocated.

By adopting the following resolution, the Association gave its endorsement of Senator Owen's bill creating a National Board of Public Health, and the committee appointed will endeavor to secure dental representation thereon.

Resolved, That the National Dental Association, a delegate body, representing the State dental societies of the United States, in convention assembled at Denver, Col., July 19-22, 1910, heartily endorses the object of Senator Owen's bill for a Department of Public Health, and that a communication to that effect be sent to Senator Owen and the Senate and House Committees to which the bill has been referred.

Bill to Revive Crown Company Patents.

Much perturbation existed in some quarters over the report that a bill had been introduced into Congress which aims to revive the patent granted to James E. Low. It appears that representations have been made in Congress to the effect that the holders of this patent have been prevented from obtaining just compensation therefor through a conspiracy of dentists. It was also stated that there seemed to be considerable reason to expect that the bill would be passed, and that an attempt would be made to collect some $8,000,000. This possibility greatly troubled the pessimists present, while the optimists, looking as always upon the silver lining rather than upon the cloud, expressed pleasure at learning that the dentists of this country have such a sum as $8,000,000 in bank. However, the Association deemed it well to imitate the wise cat, who, having chased the mouse through a small aperture, then sat down to "watch the hole." Below will be found a copy of the bill, and the resolution passed at Denver.

61st Congress, 2d Session. S. 8593.

IN THE SENATE OF THE UNITED STATES.

JUNE 8, 1910.

MR. CULLOM introduced the following bill; which was read twice and referred to the Committee on Patents.

A BILL

To renew and extend certain letters patent.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that certain letters patent for an alleged new and useful improvement in dentistry, dated March fifteenth, eighteen hundred and eighty-one, and numbered two hundred and thirty-eight thousand, nine hundred and forty, granted to James E. Low, be, and the same is hereby, renewed and extended to James E. Low for the term of seventeen years from and after the passage of this Act.

Resolved, That a legislative committee of five be appointed to look after legislation in Congress which may in any way affect the interests of the people through affecting the dental profession.

Analysis of Dentifrices.

The following appeal to the Department of Agriculture of the United States was likewise recommended by the Council and adopted:

To the Department of Agriculture, Washington, D. C.

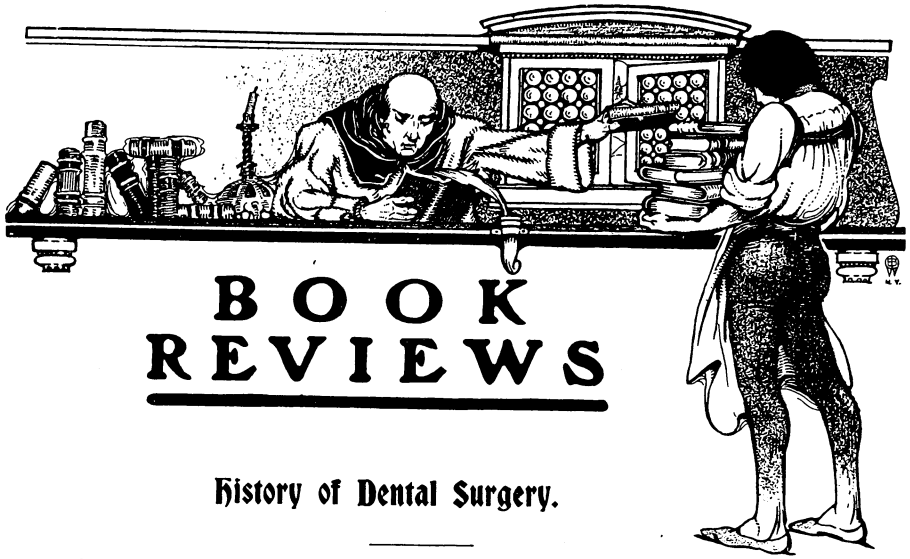
WHEREAS, The National Dental Association is in session at Denver, Col., July 19-22, 1910, and

WHEREAS, It is of the utmost importance to the dental profession and the public at large that there should be full knowledge concerning the real worth and true ingredients of dentifrices and mouth washes generally prescribed and used;

Therefore be is resolved, That the Department of Agriculture at Washington be respectfully requested to undertake the analysis of the generally used dental preparations with the purpose of publishing their findings for the guidance and instruction of the dental profession at large.

Be it further resolved, That these resolutions be inscribed on the minutes of the National Dental Association, and

Be it further resolved, That the Secretary be instructed to forward a copy of these resolutions to the Department of Agriculture at Washton, D. C.



BOOK REVIEWS

History of Dental Surgery.

Contributions by various authors, edited by Charles R. E. Koch, D.D.S., Secretary and Lecturer on Dental Economics of Northwestern University Dental School. In two volumes. Published by The National Art Publishing Company, Chicago, 1909.

This monumental work, consisting of 1,186 pages of interesting dental history in the first volume, and 681 pages of dental biography in the second, both volumes profusely illustrated, is by far the most reliable and the most complete history of dental science the world has so far seen. To American readers and those interested in the development of the science in the United States it is an acceptable complement to the recently published "History of Dentistry," by Dr. Guerini, of Naples, Italy. Dr. Guerini treats of the early history of the science throughout the world from the first available data to about 1800; the work under review, while giving somewhat briefly a general history of the development of the science from early antiquity, is especially a history of the science in the United States. Inasmuch as the available data for such a work is widely scattered and only to be obtained by industrious research, the author wisely divided the labor among writers known to be interested in some phase of dental history. All through the work we find evidence of thoroughness in the effort to present facts, to discard accepted records of doubtful authenticity and to present carefully considered gleanings from original sources.

The *History of the Development of Dentistry,* by Dr. Koch, covers the period from the first available records of Egyptian antiquity, its progress in France and England, its migration to America and subsequent development in the United States to date. It is well written, and sufficiently full to serve as an introduction to the work.

The *History of Operative Dentistry,* by Edmund Noyes, D.D.S., of Chicago, follows, giving a concise résumé of the various operations recorded in the older works of various authors, and more especially a full and interesting account of the gradual development of operative dentistry in its various phases in the United States. The history of the many filling materials and their manipulation, pulp treatment, methods of operating, dental drugs, instruments and appliances, he has woven into an interesting and instructive story.

Henry Lovejoy Ambler, M.D., D.D.S., of Cleveland, Ohio, follows with an equally interesting history of *Dental Prosthesis.*

The *History of Orthodontia,* by S. H. Guilford, A.M., D.D.S., Ph.D., of Philadelphia, completes what may be termed the history of the practical side of dental science.

Dental Journals of the United States, by William H. Trueman, of Philadelphia, is an appropriate beginning of the history of the rise and progress of the profession's educational interests, for the publication of the first dental journal marked the beginning of a new era for dental science, not only in the United States but throughout the world.

Edward C. Mills, D.D.S., of Columbus, Ohio, follows with *An Historical Review of Dental Literature,* which, while not as full as it might be, considering how scattered the material is, and that there are in the United States so very few dental libraries, is well done and is, perhaps, the best general review of dental literature so far produced by an American writer.

Drs. Koch and Truman W. Brophy give a few pages to *Oral Surgery,* the connecting link between the mechanical side of dental and medical sciences.

Then follows the most important and instructive part of the work, nearly 800 pages, treating of *Dental Education and Dental Schools; Dental Laws and Legislation; Dental Jurisprudence; Dental Societies,* and *International Dental Congresses and Dental Federations,* as they have developed and expanded in the United States.

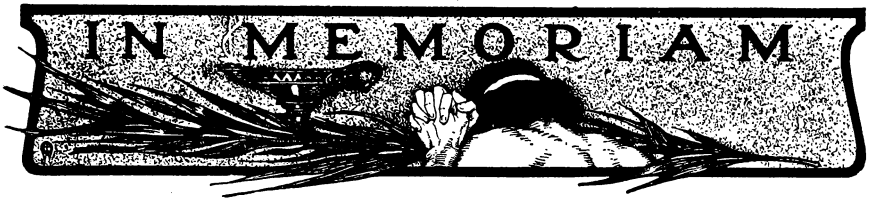
The second volume is edited by Dr. Burton L. Thorpe, of St. Louis, Mo., and is a reprint, revised and extended, of the interesting biographical sketches which he has from time to time contributed to several dental journals. Dr. Thorpe's work is especially to be commended. With unflagging industry he has sought out the life history of many of the

men to whom we are indebted for the present advanced standing of our profession, and has placed on record a thoroughly reliable record of their beginning, their trials and their triumphs, their professional accomplishments, and the part they took in making dentistry better than they found it. To these sketches he has added their portraits. It has been to him a labor of love, and is well done.

One can not too highly commend the work of Dr. Koch, as presented in nearly 800 pages devoted to *Dental Education* and the *History of Dental Schools.* During the five years or more that the work has been quietly maturing, he has industriously collected the histories of the dental schools, national, state and local dental societies in the United States, and during the progress of the work, by constant correspondence has kept this material up-to-date, until the last moment of publication; indeed, the last corrections were made as the work was passing through the press. In this work he has been assisted by a corps of about one hundred and seventy contributors.

It is a work that commends itself to all practicing dentists who are interested in their profession's welfare and its history and development. That it is so widely practiced, that it has so many agencies for advancement that appeal only to those interested in dental science as a science, as here shown, makes one feel proud of the profession, and should be an incentive to all to own so instructive and interesting a work.

W. H. T.



William B. Mead.

The members of the Rhode Island Dental Society announce with sorrow the death of Dr. William B. Mead, their oldest and one of their most beloved members.

Dr. Mead was a man of broad, sterling character, skilful and conscientious in his chosen field, and kind and sympathetic as a friend.

His exemplary life is an inspiration to young men entering the dental profession, and his absence from our meetings will, indeed, be sadly felt.

FORREST G. EDDY,
ARTHUR M. PORTER,
ALBERT L. MIDGLEY,
Committee.